An Anthropological Study on Traditional Astronomers of Bangladesh

Supervised by

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THIS DISSERTATION HAS BEEN PREPARED IN FULFILLMENT OF THE REQUIREMENTS
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DECLARATION

This PhD (Doctor of Philosophy) thesis has been prepared to submit to the Department of Anthropology, Faculty of Social Sciences, University of Dhaka, Bangladesh in fulfilling the condition of the PhD program.

The material presented in this thesis is, to the best of my

Knowledge, original and has not been submitted in whole or part for a degree in any university.

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CERTIFICATE

It is my pleasure to commence Mohammud Monjur-Ul-Haider as a PhD Scholar of the Department of Anthropology, Faculty of Social Sciences, University of Dhaka, Bangladesh who has prepared and accomplished his PhD Dissertation entitled "**An Anthropological Study on Traditional Astronomers of Bangladesh**" under my supervision.

This dissertation is submitted for the fulfillment of the requirements for the Degree of Doctor of Philosophy (PhD) in Anthropology, Faculty of Social Sciences, the University of Dhaka, during the session 2012-2013.

Supervisor

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Dedication

Sohoja and Sorola, the center of my universe

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Introduction

The impact of astronomy on our idea of the universe has been strange and mysterious through time immemorial. Discoveries that the earth is not in the center of the universe, or that the universe has been expanding for billions of years, affect our thinking and our understanding in relation to space and time. Throughout history, observations of the universe have had a major impact on people. Most of us study astronomy not for its technological and philosophical benefits, but for innate interest. Ultimately, we enjoy astronomy, because of its fascination and mystery.

1.1 Background

Men have been trying to know about the mysterious universe from the ancient times. The unlimited sky with its innumerable stars, planets, and many other celestial bodies is always a great wonder to us. Astronomy, arguably, is the oldest of the natural sciences; it is defined as the branch of science that deals with everything outside of the earth's atmosphere. Celestial objects and phenomena, space, and the universe are the subject matter of astronomy. In the past, people had to make sense of what they see in the sky, and used the sky to guess the rest of the world. They studied the movement of celestial objects to help them for timekeeping, to guide them in hunting, navigating and planting, to determine principles of leadership and community, and to predict and explain terrestrial events. Selin argues that Astronomy was essential for regulating the calendar and eventually for navigating and map-making (Selin 2000: xix).

History shows that the people of ancient Greece are the pioneers in Astronomy; thus, the Greek civilization has been called as the cradle of Astronomy. The Greeks would use only their logic and imagination about the universe; however, their thoughts and imaginations were not confined only to themselves. They also influenced the people of South-Asia including Bangladesh. According to Pingree, there are a number of Indian astronomical texts that are dated to the sixth century or later with a high degree of certainty. There is substantial similarity between these and pre-Ptolomaic Greek astronomy (Pingree 1976). A revolutionary change took place in this sphere when the telescope was invented and transport facilities were improved during the Renaissance. Human began to think about the space in a different way, and since then Astronomy has been considered a part of science. Nicolaus Copernicus

(1473−1543) initiated the revolution in astronomy from the publication of his book *De revolutionibus orbium coelestium* (*On the Revolutions of the Celestial Spheres*), just before his death in 1543. The religious and philosophical implications of astronomical discoveries have been discussed, especially since the time of the Copernican revolution, which made Earth a planet and the planets potential Earths. Works followed this from a number of scholars, including Galileo Galilei (1564-1642), Tycho Brahe (1546−1601), and Johannes Kepler (1571−1630) who pioneered the development of Western science (Kuhn 1962; Westfall 1971; Heilbron 2003). Isaac Newton (1642−1727)'s law of universal gravitation has resolved many mysteries of the space. Since science does not have a final word, our ideas are constantly changing with the addition of newer knowledge in this field.

As early as 200 BC, the Babylonians charted the position of the heavenly bodies to predict events on the earth. The making of such predictions is based on the belief that the positions of the stars and planets influence what happens on the earth. The ancient Egyptians, Greeks and Romans also practiced astronomy, and many early astronomers believed in it. Jabbar (1976) discusses various types of ancient astronomy that exist in different parts of the world. He explains how thinker's notions related to the heavenly bodies that emerge in ancient Egypt, Babylon, Greece, Chinese and Indian Astronomy. Michael Hoskin's edited "The Cambridge Illustrated History of Astronomy" (1997), offers a unique account of astronomical theory and practice from antiquity to the present. Many scientists simply do not ignore traditional astronomy, but actively oppose it as a superstition or a pseudoscience that deliberated the advancement of this study. The earliest recorded astronomical study dealt with the eclipses, the sun, the moon, and the pathway of the sun across the sky. The records of the early astronomers of China and the Mesopotamia Valley show that they had learned to distinguish between the ecliptic (the annual path of the sun across the celestial sphere) and the celestial equator; in fact, the early Greek astronomers noted that the intersection points of these two circles were moving or processing from year to year.

The first records of sophisticated astronomy in India date back to at least 2000 BC, where ancient astronomical observations are found in the *Rigveda* (1700-1100 BC). The ancient Indian astronomers used the stars and the planets to create celestial charts, through which they read good or bad omens. They also made some devices, sophisticated mathematical models and developed many interesting theories. The *Jyotisa Vedanga* is the first Vedic text that dealt with astronomical data. Although many archaeo- astronomers point out that some

of the records may have been copied from earlier manuscripts, this is an area where more research is required, as many of the references are murky and embedded in religious terminologies.

However, astrology[1] and astronomy came together under the name 'traditional astronomy'[2] in Indian subcontinent. Sastri (1993) is both an astrologer and a traditional astronomer who has practiced astrology in India and other South-Asian countries. He attains considerable experience in providing astronomical services. Attempts have been made to throw light partially on the principle behind the rule and canons of Indian astrology in order to bring it in a rational line of thinking out of the anomaly, ambiguity, doubt, confusion and controversy. Astrology has been around for a long time, but it has never been shown to work scientifically. Believers may cite incidents that reinforce their faith in astrology, but no successful scientific tests have ever been carried out. From the astronomer's view, astrology is meaningless, unnecessary and impossible to explain if we accept the broad set of physical laws conceived over the years to explain what happens on the earth and in the sky. Astrology patently does not work, the only reason people may believe that they have seen astrological work is that it is a self-fulfilling means of prophecy, conceived long ago in times when it was known less about exciting things that are going on in the universe. Astrology and traditional astronomy possess the distinctive qualities along with similarities, such as-

a) Traditional astronomers give emphasis on heavenly bodies for prediction purpose; on the other hand, astrologers concentrate on secondary sources only;

b) with an objective to define agricultural seasons, weather forecasting, including drought, rainfall, flood, and some other natural calamities, traditional astronomers depend on the indication of sun, moon and stars. For astrologers, there is no way to determine these aspects;

c) Traditional astronomers are supposed to use scientific tools and techniques to observe the sky while astrologers are very blind about the matter;

d) Astrologers are more commercial than traditional astronomers are. They like to live in congested dwellings like urban areas while traditional astronomers are often available in the remote rural areas where mass media cannot play a dominant role.

[1] Astrology is an attempt to predict or explain our actions and personalities based on the positions of the stars and planets now and at the instants of our birth.

[2] Traditional astronomy is the use of astronomical phenomena to predict earthly and human events, in terms of assumed theoretical system.

As a rule, Anthropologists hate definitions (Donovan 2008:03) and for good reason, they are required to take a critical view. Therefore, the present study is also necessarily participatory regarding cultural aspects of astronomy, and of course regarding traditional astronomy.

1.2 Study Questions

After the 'Big-bang test[3],' we have witnessed a rebirth of astronomy as an exuberant area in natural and social sciences. Modern astronomy is an emerging field for the student of natural sciences while traditional astronomy is lagging behind. Traditional Astronomers are living in the remote rural areas where urbanization is yet to reach, but they enjoy much honor from the countryside community. Their thoughtful statements can illustrate most of the economic events, cultural activities and social issues of rural people. Bangladesh is nevertheless characterized as a 'fatalistic society' (Chowdhury 1978), traditional astronomers are important human resources in this connection; their roles are significant and meaningful to mitigate the challenges of such type of society. They are playing a role in keeping social peace and cohesion. However, by changing cultural norms, they are losing their social status and going to be marginalized as compared to other occupational groups. It is imperative that we know their present status and document each of their events categorically.

In this thesis paper, the researcher addressed three questions: first, the ontological question is 'what is the form and nature of traditional astronomy in Bangladesh?' In search of the answer, the researcher finds traditional astronomy is being formed with science and pseudoscience, and it is usually rural in nature; second, the epistemological question is 'why the trust-level of people regarding traditional astronomy is changing?' In answering the query, the researcher explores people's perception of the subject comes naturally – there are few fake and quacks who are doing unfair works. If it is practiced through curricular activities, superstitions will go away; it would be recognized as an enthusiastic subject matter; finally, another epistemological question is 'how do social, economical, cultural, and religious factors operate behind the professionalism of traditional astronomers? The research explores the profession is not attractive and the new generations are not interested in it since their elderly generations are poorly paid; mostly involved peoples are from Hindu community are involved in this profession.

[3] 30 May 2010, Scientist of Switzerland Conducts 'big bang' test successfully. The experiment had helped scientists to find out new properties of nature.

1.3 Significance and Rationale

Astronomical knowledge in general view is nevertheless of great practical value, and bearing less directly upon the material interests of human life than many other disciplines. It is by means of astronomy that the latitude and longitude of points upon the earth's surface are determined, and by such determinations alone is it possible to conduct extensive navigation. Another instance, can be drawn simply that ebb and flow of water causes by the influence of solar and lunar system. Therefore, it is important for a man to know at least ABCD of astronomy.

Astronomy is a good way to generate interest in indigenous culture among the public (Fienberg and Beatty 2005:85). New York Times survey finds astronomers and physicists have the fifth most prestigious occupation in America (as quoted by West 2009) and astronomy is a subject the researcher has personally found very useful to emphasize the intellectual achievements of rural people. Many people react positively and show true interest and curiosity when learning about traditional astronomy. On personal experience of the present researcher, very few respondents react to criticism. Thus, astronomy seems to be a good way to educate the public about traditional knowledge and culture. There are several reasons to study the traditional astronomical knowledge of Bangladesh. One reason is to understand and respect the intellectual accomplishments of the astronomers who are practicing astronomy by tradition. Many of those accomplishments are unknown to most mainstream people and scholars, and this ignorance stimulates negative perceptions about traditional astronomers.

The night sky was useful for practical and cultural purposes (Stanbridge 1861 and Tindale 2005). Different environmental conditions at different geographical locations mean that the particular application of astronomy in one area may have little or no practical use to cultures in another area. For example, Polaris (α *Ursa Minor*) is a resourceful celestial tool for navigating in the northern hemisphere, as it lies very close to the north celestial pole. There is no such pole star in the southern hemisphere, which forces southern hemisphere cultures to develop alternate navigational techniques. The climate and weather patterns and their relationship to the motions of celestial bodies visible from Mesopotamia, Canada, or Greenland have little or no application to people in Arnhem Land (a vast wilderness area in the northeast corner of Australia), Fiji, or South Africa. Stars near the north celestial pole are invisible to most places in the Southern Hemisphere (depending on latitude) and vice-versa (Hamacher 2011:43). In order to obtain a complete and accurate picture of the use and

context of traditional astronomy in Bangladesh, it is important to understand the application of astronomy to its culture in a separate context, considering these variables. Historically, sun, moon, and stars occupy an important place in the people's perceptions of this region. For instance, the sun is important as a provider and protector of our agriculture-based economy and cultures and possibly that is why it has been incorporated into the national flag of Bangladesh.

It is surprising but true that there is not a single anthropological research work on such vital issue in the traditional society in Bangladesh. It is necessary to analyze each and every issue in understanding any traditional society. Traditional astronomers play a significant role in the everyday life of the rural life of Bangladesh. They are playing an important role: i) to build new household, ii) to fix dates for marriage and other ceremony, iii) to forecast weather and everyday climatic condition, etc. Most of the traditional astronomers are not conscious about their knowledge; they do not keep any written record of that. However, it has been already proved that their knowledge is scientific and eco-friendly than others. Latterly, they are living in miserable condition; mass media like- radio, television, newspapers etc. has shortened their work circle. Since most of the traditional astronomers belong to the Hindu community, they migrated to India during/after the liberation war of 1971. Those who are still in the country are devoid of a modest living conditions. Therefore, it is very significant to identify the traditional astronomers of Bangladesh and document indigenous skills for our coming generation side by side for those who are in the quire of astronomical knowledge.

There is a growing body of knowledge of traditional astronomy (in the name of archaeoastronmy, ethnoastronomy, and cultural astronomy) there has no corresponding study in our country, and this study was developed to fill the gap through a comprehensive research and analysis of the literature and current knowledge. This research will try to point out some possible explanation for their marginal life.

1.4 Objectives

The study has two prime objectives. The first objective aims to identify the traditional astronomers of Bangladesh and the nature of traditional astronomy. The second objective is to know people's perception regarding traditional astronomy/astronomers. Under these two prime objectives, following supportive objectives are addressed for a holistic view:

1. To know the socioeconomic and religious background of the traditional astronomers, and to assess their professionalism;

2. To assess their acceptance and importance in rural communities;
3. To explore the areas where astronomical predictions are prescribed; and
4. To evaluate the effectiveness of different astronomical predictions.

1.5 Methodology

The study conducted by following an inductive approach, where conjecture comes through observations, study questions, tests and analysis. Ontologically, the researcher follows objectivism – where facts exist independently. Epistemologically, the study followed positivism – by using scientific principles to study the phenomena.

1. **Methods:** Through observation, some surface look was made in the physical settings of the respondent. Informal interview method was of great help to collect precise data. Use of key informant and case studies were supportive for data collection, cross checking and triangulation too.
2. **Techniques of the Data Collection:** Star mapping, photography and audio-visual recording were techniques for data collection.
3. **Study Duration and Area:** Duration of fieldwork is 11 months in six schedules: August to September-2013, November to December-2013, July-2014, September to October-2014, June to July 2015, September to October 2015. This study was carried out in different parts of Bangladesh. The study follows purposive sampling and 50 respondents from the 17 (11 rural/ 2 urban/ 4 semi-urban) areas under seven divisions of Bangladesh. From each division at least two areas were selected so that a holistic picture of the country could be drawn. A list of study areas is given below (the details are in chapter 3, table 3.1):

   Barisal: *Gouranodi (1 Semi-urban area: Bamrail)*; *Babuganj (1 village: Thakurmallik)*

   Chittagong: *Cox's Bazaar (two villages: Joldaspara, Ghuniya)*

   Dhaka: *Gopalganj (2 villages: Paschimparh, Basudevpur), Madaripur (2 villages: Paschim Baligram & Shasikar)*

   Khulna: *Magura (1 urban area: Notunbazar), Satkhira (1 Semi-urban area: Jhutitala)*

   Rajshahi: Joypurhat *(1 village: Uchai)*, Sirajganj *(1 urban area: Enayetpur)*

   Rangpur*: Mithapukur (1 semi-urban area: Gopalpur), Kurigram (1 semi-urban area: Chor-Gobindapur)*

Sylhet: *Habiganj (1 village: Jatukornopara), Moulovibazaar (1 village: Kornygram), Sunamganj (1 village: Bagmara).*

The respondent category, their numbers, and techniques of data collection that has been used in this study provided in the following table-

TABLE-1.1: Respondent Category and Research Methods

Respondents	Method/Technique	Number of Respondents	Comment
Traditional Astronomer	Case Study, Life History, Key Informant & Informal interview	28	Their number was less historically, are mainly found in far-reaching rural areas
Client	Case Study, Informal interview & Focus group discussion	12	Peoples from all walk of lives could be a client.
Middleman/Disciple	Case Study, Observation & Informal interview	5	Usually close kin and neighbors are selected in this regard
Modern Astronomer	Case Study & Formal interview	5	They are mainly found in urban areas
Some Astronomical Associations	Observation	2 (not in person)	
Total Respondents		50	

4. Data Presentation and Analysis: After the collection of data, they were described and analyzed. Both qualitative and quantitative treatment was given so that a holistic view can be developed. The data and information were analyzed from multidisciplinary (Cultural Astronomy, History, Astrophysics, and Mathematics) perspectives, especially from anthropology.

1.6 Limitations

There have been some limitations to conduct this research that was assumed as reducible factors:

Respondent Selection: It has been difficult to find an authentic traditional astronomer. After asking a few questions and cross checking, the researcher had to select the very respondent.

Lack of Available Secondary Data: Information (Literature) about the research topic is rarely available. It was, therefore, harder for the researcher to conduct a worthy research work. Inadequate information has caused a problem that is limiting the scope of data analysis.

Poor Prior Research: Lack of prior research on the traditional astronomy limits the opportunity to compare the study.

Obscurity: The impact and influence of planets and stars is obscure to the researcher, so a long discussion and debates has been done to reveal it.

Apart from the above mentioned factors, another substantial factor is the difficulty in separating ‘traditional astronomer’ from ‘astrologer’ but it was later resolved.

Chapter Two

Cultural and Traditional Astronomy

Astronomy is the science of the heavenly bodies- the sun, the moon, the stars, and the planets, the satellites of the planets, meteors, comets and nebulae (De 1964). According to Khan and Sikder (1968), 'astronomy means mapping, classification, description and investigation of the movements of stars and other heavenly bodies.' They also added that, 'since astronomy deals with phenomena and the astronomers study the heavenly body from a distance, this science is intrinsically observational.' Jabbar (1976) seeks to offer an understanding of astronomy, concept and framework for ancient astronomy. Astronomers observe and record the positions and appearances of the heavenly bodies and interpret the nature and constitutions of the entire universe around us.' Astronomy is the branch of science that includes the study of the universe beyond the earth, and all that it contains. It is one of the ancient sciences and began in ancient times. Throughout history, the study has served such practical purposes as keeping time, marking the arrival of the seasons and navigating in the sea. The astronomer seeks to understand the nature of the objects they observed in the universe and explain the events taking place. Cultural astronomy is the study of the effect of astronomical knowledge or theories on ideologies or human behavior (Campion 2003). In the present chapter, cultural astronomy and traditional astronomy are discussed with their adjacent events so that it would be easy for further understanding. At the ending of this chapter astronomical myth and their cross-cultural meaning decoded.

2.1 Traditional Astronomy: Search for a Definition

Early terms such as archaeoastronomy (Elizabeth Baity 1973), Astro-archaeology (Hawkins 1966), ancient astronomy (Thom 1967), cultural astronomy (Platt 1991), ethnoastronomy (Griffin-Pierce 1992), and aboriginal astronomy (Fredrick 2008) were used in place of traditional astronomy. Ruggles (1999:155) argue that the term Ancient Astronomy is misleading since modern astronomy is a scientific discipline. The term Ancient Astronomy assumes that astronomy, as it is practiced today, was identically practiced in the distant past cultures. Cultural astronomy is the set of interdisciplinary fields studying the astronomical systems of current or ancient societies and cultures (Holbrook et al. 2008). It is sometimes called the "anthropology of astronomy" (Platt 1991) and incorporates the sub-disciplines of

archaeoastronomy, ethnoastronomy, and historical astronomy.

Astronomers and anthropologists recognize that many scholars have tried in many ways to understand traditional astronomy; but there is no good-articulated description that covers it with exact meaning. Since the present researcher, accomplished an MSS thesis on roughly similar topic, thus he has a good understanding of what constitutes the traditional astronomy. However, it may be defined for the thesis purpose as:

> Traditional astronomy is an interdisciplinary study that explores astronomical aspects with its long-established cultural context.

This definition rests on three subsidiary terms, which require further explanations of their own. They are- 'interdisciplinary studied,' 'astronomical aspects,' and 'long-established cultural context.'

Interdisciplinary study: Interdisciplinary study is an academic process that attempts to synthesize broad perspectives, knowledge, skills, interconnections, and epistemology in an educational setting. From its beginning, traditional astronomy incorporates multiple academic disciplines into its subject matter. It combines astronomy, physics, mathematics, statistics, anthropology altogether. It is creating something new by crossing disciplinary boundaries, and thinking across them.

Astronomical aspects: The basic science of astronomy and its branches are responsible for studying the celestial objects (such as- stars, galaxies, planets, moons, asteroids, comets and nebulae), and other related things. Traditional astronomy as an exuberant branch of astronomy studies stated objects in its own approach.

Long-established cultural context: This is an established study that comes gradually not overnight. Astronomy focuses on physical aspects of celestial bodies while traditional astronomy concerns with social and cultural aspects as well. It looks at the social meaning of starry sky. Those meanings are culture-specific; various values and attitudes, different rituals observed in different parts of the world. Traditional astronomy has existed for a long time that means it evolves from prehistory to present through ancient, medieval, and modern time.

In the context of this thesis, 'traditional astronomy' does not simply refer to stories related to the sky or the naming of space objects. It implies an intellectual search to gain a deeper understanding of the nature and motions of space objects and phenomena, their relationship to events on the earth, their origin and composition, and the ways they can be used for practical purposes. Did local people make predictions based on observations of the sky and land? Alternatively, are the oral traditions and art forms related to the night sky simply a

reflection of abstract beauty that contain nothing of practical importance? In fact, there are several reasons to study the traditional astronomy. One of the reasons is because of the respect that astronomical knowledge produces, both in the academic world and among the mass people. Studies in traditional astronomy have a huge potential for raising awareness of and promoting people, who are unheard.

2.2 Traditional Astronomer's Perception about the Cosmic Order and Universe

When we explore the cosmos, we also explore ourselves (Bhaumik 2008). Different studies of the literature on aboriginal astronomy (Fredrick 2008; Hamacher 2011) have shown that there is an affluent knowledge of aboriginal astronomy in the text, much of which is based on ethnographic effort. This knowledge covers from simple expressions to complex cosmologies. The traditional conception of the cosmic order is not to be compared with modern scientific knowledge. Traditional astronomers of Hinduism belief that, there are two fundamental principles of nature- matter and life- that causes the origin of everything. Matter enters into the compositions of all beings. Life possesses an ontological rather than a psychological function. It is hard to separate mind from matter. The mind is a formless matter. The mind of Brahman is the universal mind, the mother of mind. The mind follows faith and faith follows the heart where the mind is seating. The unity of mind and wisdom follows the divine light of the self. Human is conscious of nature (matter), just s/he is aware of thyself. S/he is made of matter, but is more than matter. The understanding of cosmic order makes a person boundless, it happens because the universe is boundless. However, it will reveal to us more clearly from the following box (it is indeed a traditional astronomer's perception regarding the universe)

Case-2.a: Cosmic Order and the Universe

Subodh Bose*, 75 is an elderly priest. He learned astronomical knowledge from his Guru (religious leader) at the temple. He stated (informal interview for the researcher 12 December 2013), 'the genealogical descent of the universe and human comes from spirit and matter. Shantanu (the transcendental Brahman) had two consorts: Ganga (a conscious aspect of nature as intelligence) and Satyavati (primordial nature as matter). Ganga's son was Bhisma (universal ego) and Satyavati's children were Vyasa (consciousness of relativity), Chitrrangoda (divine primordial element) and Vichtravirya (divine ego), who had two wives: Ambika (negative doubt) and Ambalika (positive discriminating faculty). Ambika's son Dhritarashtra (the blind sense mind) has two wives; Gandhari (the power of desires) and Vaishya (the attachment of desires). Gandhari's son was Duryodhana (vainglorious desire) and his brothers, the ninety nine other Kurus (sense tendencies). Vaishya's son was Yuyutsu (the desire to give psychological battle). Ambalika's son Pandu (buddhi, the pure discriminating intelligence) had also two consorts: Kunti (the power of dispassion) and Madri (the power of attachment to dispassion). Kunti had three sons: Yudisthira (vibratory ether element), Bhima (vibratory air or life-force element), and Arjuna (vibratory fire element). Madri had two sons: Nakula (vibratory water element), and Shadeva (vibratory earth element). Draupadi, the consort of the five Pandavas, signifies the coiled life force that energizes the spinal chakras. Sri Krisna (the universal spirit incarnated on earth and Kunti's brother's son.' Mr. Bose continued, recalling from Brihadaranyaka Upanishad (dated to 8th and 7th Century BC), Yagnavalkya describes the Universe to Gargi in the following terms:

I. Everything on earth is wrapped in water
II. Water is wrapped in air
III. Air is wrapped in sky
IV. Sky is wrapped in the world of the Gandharvas (planets)
V. Worlds of Gandarvas are wrapped in Aditya (Sun)
VI. The world of the Sun is wrapped in the world of Chandra (Moon)
VII. The world of the Moon is wrapped in the world of the Nakshatra
VIII. The world of Nakshatra is wrapped in the world of Deva's
IX. The world of Deva's is enclosed in the world of Indra
X. The world of Indra is wrapped in the world of Prajapati
XI. The world of Prajapati is wrapped in the world of Bramhana

Mr. Bose opined that this universe is the multilayered and infinity of numbers is a common theme to the cosmogony of not only the Hinduism, but also to Jainism and Buddhism that arose from the same intellectual pool of 5th century BC.

**Name used in this paper is pseudonym in order to protect the identities of the participants*

Early astronomers thought that the earth was the center of the universe and that everything revolved around it. However, according to the modern astronomer's view, the earth is the only one of the nine planets that orbits the sun. Our solar system has attracted the traditional astronomers for a long time. It consists of one star (our sun) and all the objects that orbit it. These objects include: a) the nine planets and their satellites b) thousands of smaller bodies called asteroids, c) meteoroids, d) thousands of comets, and bits of rock and ice that may become comets, e) particles of dust and gas. The sun itself is only an average sized star, one of the billions of stars in the Milky Way, which in turn, is only one of countless galaxies in

the universe. Astronomer measures distances within the solar system in astronomical units. One astronomical unit is the average distance (about 5.4 light years) between the earth and the sun, that distance varies as Earth orbits the Sun, from a maximum (aphelion) to a minimum (perihelion) and back again once a year. The next extension of astronomical study beyond the solar system is the observation of the stars. Stars are glowing balls of gas that exist throughout space. They vary in temperature, color, brightness, size and mass. Mass is the quantity of matter in a star. New stars are always forming in space. A new star begins to form when a cloud of gas and dust contracts into a ball. Astronomer measures distances to and between the stars in light-years. A light-year is the distance that light travels in a year; it is almost 5.88 trillion miles (9.46 trillion km.) The star nearest to the sun, Proxima Centauri, is 4.3 light years from the sun.

Our solar system is only a minor member of the giant grouping of stars, dust and gas that makes up our galaxy, the Milky Way. There are innumerable other galaxies in the universe. The universe consists of all space and all the matter and energy that space contains. Traditional astronomers do not know how large the universe is. It may even extend to infinity. Nearly all modern astronomers believe that the universe began between 10 billion and 20 billion years ago within an explosion called the 'big bang'. According to this model, the universe expanded from an extremely dense and hot state and continues to expand. At first, the universe consisted chiefly of radiation, but as the universe continued to expand, most of the radiation changed into matter. The remainder of the radiation can be defected today in the form of faint radio waves coming from all parts of the universe. In 1965, the 'cosmic microwave background radiation' was discovered, which was crucial evidence in favor of the Big Bang model, since that theory predicted the existence of background radiation throughout the universe before it was discovered. More recently, measurements of the redshifts of supernovae indicate that the expansion of the universe is accelerating, an observation attributed to dark energy's existence (Peebles and Ratra 2003:560*).* Today, all of the clusters of galaxies in the universe continue to rush away from one another. Whether, the universe will continue to expand forever or whether it will eventually contract is the subject of much astronomical research (The World Book Encyclopedia 1987:838).

2.3 Conception of the Heaven

The conception of Heaven evolved from the scientific astronomy and traditional mythology. Traditional mythology is the interpretation of scientific astronomy in a mythological format.

Mythology symbolizes the movements of the heavenly bodies within the cosmos. Astronomy deals with charting the cycles of all the entities within the cosmos. The Prophecy that prevails in Mythology and religion is a result of this charting. The Prophecy did not pertain to the future human activity. The Prophecy pertained to the future movements of celestial entities.

Since the traditional astronomers used a mythological format to record their findings, their predictions of future cycles were transformed into the prophecies of the deities, their future conquests, plotting, wars, and defeats. So when religion evolved from mythology, the chain continued. The predictions of the traditional astronomers (Astrologers/Mathematicians), that became the predictions of mythical deities, when recorded under mythological headings, continued as the prophecies of messengers from God, in their religious format.

The heavenly region above the equinoxes was viewed as a land of delights, a green Garden of Eden. In some cases, the region was viewed as filled with heavenly Angels nourished with Sweet Milk and Honey. The Egyptians, the place of the Canaanites, the Hittites, the Amorites, and the Perizzites, the Hivites, and the Jebusites also observed glory lands with flowing milk and honey. The Sages described heaven as having Honey, because of an Asterism located within the sector of Cancer, which is the Highest Point of the Sun's northerly journey. This Asterism is known as the Beehive (A storehouse of Honey). They described the heavens as flowing with Milk, because of the celestial river that flows from the celestial Polar Regions outward in two branches. They called this Nourishing river, The Milky Way (Jabbar 2014**).**

Saraswati in his book entitled 'Culture and Cosmos' (2004) explores the anthropic and cosmic perspective together to view the world. The author has stated Semitic religions and European science have helped developed a world outlook based on anthropic principle. He was also of opinion that modern man gives anthropomorphic meaning to the world system and develops an ethnocentric culture. The interpretation of culture and cosmology may be many, but only cosmic intelligence can extends its vitality to the entire world.

2.4 Astronomical Myth and Meaning

Myth as it exists in a savage community, that is, in its living primitive form, is not merely a story told but a reality lived. It is not of the nature of fiction, such as we read today in a novel, but it is a living reality (Malinowski 1926:177). Claude Lévi-Strauss's approach to myth was very thought provocating. He considers tales as miniature myths. The two genres have a

complementary relationship because tales in one society might be found in the myth of another and vice versa. He says, "Probably there is nothing more than that in the structuralist approach; it is the quest for the invariant, or for the invariant elements among superficial differences (1978: 8)." Levi-Strauss developed his ideas about mythology in a set of four volumes published between 1964 and 1971 under the title 'Mythologiques', later translated into English as 'Introduction to a Science of Mythology'. But in 'Myth and Meaning' he comes out of the Universalist secret at last. For there is something decidedly archetypal about many of his ideas when we see them expressed so starkly as they are here, as in the following assertion

> Since, after all, the human mind is only part of the universe, the need to find order probably exists because there is some order in the universe and the universe is not a chaos. (Ibid 1978:13)

Another quotation is relevant here to reveal the mental power of mankind---

> Today we use less and we use more of our mental capacity than we did in the past; and it is not exactly the same kind of mental capacity as it was either. For example, we use considerably less of our sensory perceptions. When I was writing the first version of Mythologiques (Introduction to a Science of Mythology), I was confronted with a problem which to me was extremely mysterious. It seems that there was a particular tribe which was able to see the planet Venus in full daylight, something which to me would be utterly impossible and incredible. I put the question to professional astronomers; they told me, of course, that we don't but, nevertheless, when we know the amount of light emitted by the planet Venus in full daylight, it was not absolutely inconceivable that some people could. Later on I looked into old treatises on navigation belonging to our own civilization and it seems that sailors of old were perfectly able to see the planet in full daylight. Probably we could still do so if we had a trained eye. (Ibid 1978:18)

Each of the different cultures on the earth has a distinct mythology, mythemes[4], and myth related beliefs; some of which have a strong astronomical connection. Many share common traditions such as 'emu in the sky' (called 'Naag in the sky' in Bangladesh), 'constellation of

[4] Claude Levi-Strauss called mythemes, in response to what his colleague, the linguist Roman Jakobson, called phonemes—the atomic building-blocks of meaningful sounds that make up words. Myths are made up of elements known as mythemes, which mythmakers arrange and rearrange to create meaning, often unconsciously. The same mythemes may be found in different myths, and may be reversed in myths which occur in different cultures.

stars', and various common stories regarding sun, moon, Orion, and the Pleiades. The ancient peoples observing the space saw the lion, the bull, and the scorpion in the starry sky. In fact, the night sky is a compendium of images from different societies. In worldwide mythology, there are a number of deities and devils that play the roles between the supernatural powers in the sky and humanity on the earth. Therefore, myth is a system of communication. It is not just stories; rather express symbolic truths, sometimes specific to cultures, cultural areas, and sometime universal. Since mythological thought have generated by human imagination, primarily it is based on personal experience. The images and entities generated through 'mythological thought' arise from pre-existing things in the engineer's mind (Lévi-Strauss 1966). Hoskin (1997) describes how we observed the sky and interpreted what we saw at different periods of history. He also searches for the query, how this influenced our beliefs and mythology? In addition, how astronomers are contributing to what we now know? The result is a lively and visual history of astronomy.

Astronomical myths represent the heavenly thoughts, beliefs and universe-view of the people. We owe the greatest debt to the mythology of the ancient Greeks and Romans. Star catalogue from ancient times belongs to the Roman Ptolemy of Alexandria, who grouped 1022 stars into 48 constellations during the 2nd century A.D. Although Ptolemy's *Almagest* does not include the constellations that may only be seen from the southern hemisphere, it forms the basis for the modern list of 88 constellations officially designated by the International Astronomical Union (IAU). The forces of the northern hemisphere, in their religious parallels, represented the positive spiritual natures. The Forces of the southern hemisphere represented the negative instinctive natures. The traditional mythological record dealt with the eternally conflicting forces of darkness (southern hemisphere) and the forces of light/paradise (northern hemisphere). The influence of both the Greek and Roman cultures may be plainly seen; the myths behind the constellations date back to ancient Greece, but their Latin names have been used. In fact, mythology influenced the naming of many objects in the night sky, not just the constellations. The planets bear the names of Roman gods and have attributes reasonably associated with those gods, which reflect their characteristics as well:

- Mercury, named for the speedy messenger god, revolves faster around the sun than any of the other planets recognized by the ancients except the moon;
- Venus, named for the goddess of love and beauty, shines most brightly;

- Mars, named for the god of war, appears blood-red;
- Jupiter, named for the single most important god, is the largest planet in the solar system.

Above myths seem to refer directly to the sky; others involved activities have nothing to do with it. Mercury's affiliation with the swift messenger of the gods and the divine patron of commerce makes sense. The red shade we see in the light of Mars and that planet's advances, moves, and aggressive clashes of the ecliptic, the path to which the planets are for the most part confined, understandably allied it with the god of war. In the Iliad's account of the Trojan War, however, when planet gods like Hermes (Mercury) and Ares (Mars) interact with other gods and participate in the action as characters, they cannot convincingly be interpreted as planets traveling in their customary courses. Nevertheless, some myths clearly encoded information about the natural world, and so some authorities argued the origin of myth is metaphorical description and explanation of nature (Selin, H. 2000:5).

In most traditional cultures, the Sun is female and the Moon is male (Haynes, 1992:130; Johnson, 1998), although this is not universal (As quoted from Hamacher, 2011; e.g. see Meyer, 1846: 11-12). The *Boorong* word for Tyrrell meant "sky" or "heavens" and they prided themselves on knowing more astronomy than any other Aboriginal community (Stanbridge 1858:137; 1861:301). Stanbridge read his seminal paper to the Philosophical Institute of Victoria on 30 September 1857. He wrote:

> "--- Astronomy and Mythology of the Aborigines are, as nearly as language will allow, word for word, as they have repeatedly during some years stated it to me. It is in the language of, and has been gleaned from, the Booroung Tribe, who claim and inhabit the Mallee country in the neighbourhood of Lake Tyrill, and who pride themselves upon knowing more of Astronomy than any other tribe." (Stanbridge 1858:137).

However, the attitude of Hindu communities towards the heavens and their cosmogony has evolved and astronomical myths have been transmitted orally from one generation to another. Hereunder a brief discussion of some common aspects of the Hindu's myth regarding universe.

1. Myth of Eclipses

Solar and lunar eclipses have caused fear, inspired curiosity and have been associated with myths, legends and superstitions throughout history. There is a custom to beat drums and to raise a loud din whenever there is an eclipse (Barua 1999:129) among the Khasi community

of North-East India. The Eclipses are explained in early mythologies India as a story of demon trying to eat up the Sun and the Moon. As the story goes, the sage Durvasa because Durvasa took affront to the elephant of Lord Indra trampled on the sage's gift of a garland cursed the gods. The Gods therefore lost their immortality and kingdom. They approached Lord Vishnu for help. Vishnu advised them that they could regain their original stature if they consumed the nectar of immortality from the bottom of the ocean of milk. Realizing that they needed the help of the arch foes, the Asura's they called a treaty with the Asuras. The Gods and the Asuras churned the ocean together using the serpent Vasuki as a churning rope and the mount Mandara as the churning staff.

However, once they when they began churning, the mount began sinking into the ocean. Vishnu then took the form of a turtle, to bear the entire weight of the mountain. The churning continued and various objects are thrown out, including the deadly poison 'Halahala'. The fumes of the poison threatened to destroy the Devas and the Asuras. Lord Shiva then came to their rescue. He gathered the entire poison in his palm and drank it. However, the poison was so potent that even Shiva dare not consume it. His consort, Parvathi clasps his throat and held the poison there and the throat became blue with the effect of the poison. However, even around his neck the poison was far too hot. The therefore wrapped a snake around his neck since the abdomen of a snake is cold. Hence, he became known as "Neelakanta" (literally: "the blue-throated one).

Eventually, the nectar of immortality came out of the Ocean, carried out by Dhanvantar, the physician of the Gods. The Asuras immediately took charge of the pot. Vishnu again came to the rescue in the form of a beautiful damsel, Mohini and distracted the Asuras. She then retrieved the tonic and distributed it to the Devas. By the time, the Asuras realized Vishnu's tricks; it was too late, as the Devas regained their renowned competence and defeat them.

When the nectar was being served to the gods, a demon, disguised as a god, sat between the Sun and the Moon in an attempt to procure the nectar. When the Sun and the Moon detected him, Lord Visnu immediately severed his head from his body. Unfortunately, it was not fast enough, for the demon had already tasted a small quantity of the nectar and had become immortal. Ever since, this demon is said to do revenge on the Sun and Moon whenever they come near. The head of this great demon is known as Rahu and his tail is known as Ketu. However, since both have an opening on both ends, the swallowed Sun and Moon soon emerge from the demon's body.

Cross-cultural Study: There is another version of the above myth available among the

Indonesians on the island of Bali. It was inspired by the Hindu epic, the Mahabharata. The malevolent Kala Rau (Rahu in the Indian version) is jealous of the immortal and the omniscient gods inhabiting Nirvana. Kala Rau lays his plans to achieve immortality. Disguised as a woman, he connives to be present at the gods' banquet, serving their magic elixir. Taking advantage of a disturbance, he furtively takes a mouthful of the drink, but Vishnu, aware of the crime, cut off his head immediately after he had committed it. The Kala Rau's decapitated body dies, but his head has been made immortal by the potion. Ever since, the head has chased the Moon and the Sun through the sky in an attempt to catch and eat them, but when it succeeds, they reappear, after a brief absence, through his open throat.

2 Orion Myths

2.1 Orion and the Creation Myth

One of the interesting aspects of Hindu mythology is that the internal ambiguity. On the one hand, a lord who produces the entire universe from his own thought creates the Universe. This great one is later left ambiguous while the importance of various Gods keeps changing. In the earliest myths, Indra is the most important and a warrior God, but his significance falls in later literature when the Great Trinity of Brahma (the Creator), Vishu (the Preserver) and Shiva (the Destroyer) take over. Each has a mythological story associated with it, but we shall not deal with them here since they are not related to astronomy. However, Shiva is the only member of the Trinity who is worshipped directly. Shiva himself is originally worshipped as Rudra (the angry one or the one who makes you cry). This Rudra form has an interesting astronomical association.

In the original myth of creation, Prajapati developed a desire for his own daughter Usha (in English it is called dawn). Interestingly the mother of Usha is never defined. But because this relation of incestuous, the other Gods were shocked. They approached Rudra or Shiva to prevent this incest from occurring. On the other hand, Usha herself, embarrassed by this attention kept changing her form, but each time Prajapati also took the equivalent male form out of his desire for her. It is one of these forms, when Prajapati is an antelope that is reflected in the sky in the form of Orion-Taurus. Prajapati is Taurus. The deer or the deer's head is the modern constellation, Capricorn. Sirius was the deer Piercer who shot the arrow. Orion, the hunter with a bow and arrow is Rudra tries to stop him from this sin. Invariants of this, the seed of the father fall on the ground with other consequences and there are other elaborate stories about the anger of Rudra which are not relevant here.

In some variants of this story, the brightest star in Taurus, Aldeberan (Rohini) and represents the female deer, Prajapati is represented Orion, and the three stars that form belt of Orion, are the arrow that pierced him. The arrow is Agni (fire), Soma (a celestial drink or Moon), and Vishnu (the supreme god) Agni was the fire god. Sirius and Aldebaran represent the deer Piercer.

2.2 Skanda and the Mahabharata

In the Mahabharata, a later epic and the major Hindu epic, Orion was the warrior, Skanda. Skanda was the six-headed son of Shiva. He was both the god of war and the general of the gods. Riding a red crested cock and blowing fearful sounds on a conch-shell, he thrust his spear into the White Mountain. The top split off into the sky becoming the Milky Way. The hero also killed various demons and restored peace.

2.3 Orion and the Dove

In another version of the story, Orion is a hunter who is waiting on top of a tree waiting for a hunt when he sees a beautiful deer. As he aims arrow at the dear, the dear pleads with him that while she is a legitimate catch of the hunter, she has a small baby at home and the deer would be grateful if he gave the deer a chance to meet its baby one last time before its death. The hunter lets her go, not expecting her to return. However, while sitting on the tree, unwittingly he keeps taking leaves from the Bilva tree and dropping them on the ground where there is a small Shiva Linga. The bilva leaves are particularly precious to Shiva who is pleased with this worship. The dear however, keeps its word and returns to die on the arrow of the hunter. Touched by this scene of boldness, decency and commitment to honesty, Shiva transfers them to the heavens as Orion and Taurus.

3 Ursa Major and Pleiades

In Indian mythology, the seven central stars of Ursa Major that form a cup shape, is referred to as Saptarshi meaning seven sages (sapta rishis). These are Vasistha, Bharadvaja, Jamadagni, Gautama, Atri, Visvamitra and Agastya. These seven sages are often mentioned in the later works as typical representatives of the character and spirit of the pre-historic or mythical period.

However, Agni developed a desire for the wives and wanted to seduce them. On the other hand a minor goddess or a Nymph wanted to marry Agni. She, therefore, took the form of six

of the seven wives of the Saptarshi's and mated with Agni. However, the Saptarshi's themselves uncertain about the chastity of their wives, divorced them and they went on to become the Kritika or Pleiades. Only one wife Arundhati of Vasishta remained loyal to her husband that is the binary in Ursa Major.

In other variations, Kritika or Pleiades are seven in number and not related to Saptarshi at all. They are the mothers of Kartikeya who is sometimes mentioned as one of the two sons of Shiva, but there are other suggestions, including Kartikeya being the son born of Agni and Swaha who brought up the five daughters and hence together they were called Kritikas.

4. Pole Star

The pole star is called Dhruva in Hindu mythology. Dhruva was born a son of the King Uttānapāda and his wife Suniti (or Sunrita). The king also had another son Uttama, born to his second queen Suruchi, who was the King's favorite wife. Once, when Dhruva was five years of age, the two princes playfully raced towards their father's lap. Nevertheless, the Suruchi chided Dhruva and insulted him for trying to woo the attention of his father since he was not her son. She further asked him to redeem himself by seeking Vishnu's blessings.

Suniti consoled the distraught child; by asking, him to ignore Suruchi's and meditate on the Lord. Dhruva started his penance, and went without food and water for six months, his mind fixed on the Lord. Pleased with his austerity, the Lord Vishnu appeared before him. Seeing the Lord before him, he prostrated himself before the Lord.

When Vishnu was pleased with Dhruva's austerity and asked him to ask for a boon. Dhruva said that he did not know how to sing the praise of Lord Vishnu, and therefore asked the boon of knowledge. Pleased with this, the Lord Vishnu told him that he would be great and wise King on Earth and on his death, he will be immortalized with the most revered seat of Pole Star to this six-year-old child. The Saptarshis also point remains close to an associated with the location of Dhruva.

The explanation of the above myths seems inconsistent and may include a combination of the following factors:

1. These stories indeed were not based on witnessing events.
2. These stories have been predisposed by religious beliefs.
3. A single story was incorporated into oral traditions and spread to other communities across the country.

4. Existence of supernatural power.

5. Some unscientific factor plays important role in making the story.

Myth making takes place because the ancient human being was as much as in need of explaining the course of nature and its vagaries as his/her so called civilized counterpart, so that s/he may have a sense of security and stability in the midst of constant flux of events. Such thought processes of the ancient human being, which are equally logical, get elaborated in the myths (Haokip 2010:16). In any given myth, the significance can be studied either diachronically or synchronically. Lévi-Strauss himself has always been content to see myth analysis for its own sake; though it has the potential to provide clues to other aspects of culture (Barnard 2000). Physical nature is not capable of distinguishing morality or immorality, right or wrong, good or bad. Sin or virtue, ethical or unethical is not scientific perceptions indeed.

Chapter Three

Traditional Astronomers

Bangladesh is a land of eco-mosaic. The charm of its landscape, hill, hillocks, and woods are as alluring as those of the different occupation's people who inhabits its remote rural as well as congested urban. Traditional astronomers are one of the threatened professional groups. In an unpublished master's thesis, Haider (1999) has investigated the traditional astronomers of Bangladesh. The fieldwork was carried out in the southwest Bangladesh and the analyses have shown that most of the traditional astronomers, who were mainly from the Hindu community, have shifted to neighboring countries (mainly in India) during the liberation war and the rest of them are now living in a marginalized status in the country. Modern astronomy and mass media discourage the ideas and explanation that are specified by them. It also makes them marginally among the marginalized population. Besides that, urbanization has a negative effect on the practice of traditional astronomy and obviously has a positive impact on modern astronomy. Truly, there are few research reports available that can provide explicit notions on the historical background of Bangladeshi traditional astronomers. However, based on some evidences and oral histories we can hypothetically say that it descended from Indian astronomy, particularly from Hindu astronomy- where astrology was attached uniformly. However, in the present chapter efforts have been made to obtain a primary idea on traditional astronomers of Bangladesh.

3.1 History of Astronomy in Pre-modern Indian Subcontinent

Astronomy in the Indian subcontinent dates back to the period of Indus-valley civilization during the third millennium BC, when it was used to create calendars (Bely et al. 2010) As the Indus Valley civilization did not leave behind writing documents; the oldest extant Indian astronomical text is the Vedanga Jyotisha dating from the Vedic period (Subbarayappa 1989*).* Vedanga Jyotisha describes rules for tracking the motions of the Sun and the Moon for the purposes of ritual. During the 6th century AD, astronomy was influenced by the Greek and Byzantine astronomical traditions (Bely et al. 2010, Neugebauer 1952). Kak, (2003) from Louisiana State University, USA has made an investigation for searching few questions regarding Indian and Babylonian astronomy - 'Did the Indian and Babylonian astronomy

evolve in isolation? Was there mutual influence, or was one dependent on the other?' He opines that scholars have debated these questions for more than two centuries, and judgment has swung one way or the other with point in time. He stated that the similarities between the two systems that have been investigated are:

- The use of 30 divisions of the lunar month;
- The 360 divisions of the civil year;
- The 360 divisions of the circle;
- The length of the year; and
- The solar zodiac.

In his essay, he goes over the essentials of the early Indian and Babylonian astronomy and summarizes the latest views on the relationship between them. He shows that the key ideas found in the Babylonian astronomy of 700 BC are already present in the Vedic texts, which even by the most conservative reckoning are older than that period. He also shows that the solar zodiac (rashis) was used in Vedic India and a plausible derivation of the symbols of the solar zodiac from the deities of the segments.

In view of the attested presence of the Indic people in the Mesopotamian region prior to 700 BC, it is likely that if at all, the two sets of astronomies influenced each other; the dependence is of the Babylonian on the Indian. He concludes that, it is of course quite possible that the Babylonian innovations emerged independent of the earlier Indic methods.

"Astronomy: Traditional Korean Science" (2007) introduces readers to the ancient astronomy of Korea. It was originally written in Korean language by Professor Changbom Park, and is expertly translated by Yoon-Jung Cho and Hyun-ju Park. Korean science history has mostly focused on the achievements of scientists, frequently interpreted from historical or political viewpoints, rather than the basic scientific value of their research. S.B. Rao (2001) has attempted to take a survey of the development of astronomy of India from the Vedic times to the present. He has pointed out the concepts, techniques, and computational procedures applied by the great Indian astronomers, like- Aryabhata, Brahmagupta, and Bhashkara-II, over more than a millennium and half. Jabbar (1976) seeks to discuss about different sources of Indian Astronomy, elaborating various facts; and star catalogues of Indian Astronomy.

During the present day of digital watches, electronic calculators, and accurate time on radio and television, it is hard to imagine that 1000 BC or earlier when there were no mechanical

clocks and even the idea of a calendar was unlike the present. Indian computational was few parallels anywhere in the world between third and ninth century. It is not marked by theoretical originality on the large scale, but rather by a delight in modifying computational technique and supplying revised data. An eighteenth century work in the style tends to resemble superficially a work of the previous millennium. After the tenth century, new material worked its way back into Indian from the Arab and Persian astronomers to the west. Ptolemy's best work 'Almagest' was translated into Sanskrit in 1732. There was something of a Renaissance of astronomy, a huge observatory named 'Jantar Mantar' established in Jaipur, then another in the same name in New Delhi, in India. Around the same time and some vast monumental instruments were built there; but they were of a style that Europe had long passed by. The reason for the relatively static situation, especially in the earlier centuries, was no doubt that Indian astronomer motives were largely religious and astrological. They were directed, for instance, towards the preparation of calendars for setting times of religious observances, and there was no strong drive to link astronomy with other system of knowledge. The link with physics, for example, was rarely attempted, even long after European contacts with India. In 1909, John Evershed discovered the radial motions of material, parallel to the sun's surface, in sunspots. Since that time, India has produced one of the world's leading authorities on physics of stars.

There are many other examples, but they would only serve to emphasize that although those and the traditional work may go under the single name of astronomy. Indian astronomy can be segmented into two-

a. Hindu Astronomy: The Chinese and the Greek influenced Indian, Hindu astronomers to some extent. There is a certain amount of very interesting mythological astronomy recorded in the Vedas. But the earliest formal Hindu astronomical works are '*Jyotisha Vedanga* and the '*Surya Projapati*', the latter of which exhibits a strange cosmography- with two suns, two moons etc. -while both have the crude elements of scientific astronomy. The representative Indian work, which exhibits the astronomy of the beginning of the Christian period, is the *Surya Siddhantika* of Varaha Mihira. In its original form, this work was probably composed in 400 AD, and the recession now in use about 1100 AD. Since then very little advance has been made. The orthodox still accepts the *Surya Siddhantika* as the authoritative and other works are not essentially different (Kaye 1973).

b. Muslim Astronomy: The Muslim astronomers frankly acknowledged their indebtedness to Greek writers. Indeed, they were the foremost astronomers of the world. The first major Muslim work of astronomy was *Zij al-Sindh* by al-Khwarizmi in 830 (Dallal 1999). The work contains tables for the movements of the sun, the moon and the five planets known at the time. The work is significant as it introduced Ptolemaic concepts into Islamic sciences. In 850, Al-Farghani wrote *Kitab fi Jawani* (meaning "A compendium of the science of the stars"). The book primarily gave a summary of Ptolemic cosmography (Dallal 2010). They accepted the fundamental features of the Ptolemaic system of the universe with some modifications made by Persian scholar Al-Beruni (September 973 - December 1048). Al-Biruni wrote few famous books *Qanun-i Masoodi* (*al-Qanun al-Masudi, fi al-Hai'a WA al-Nujum*), which discusses several theorems of astronomy, trigonometry, solar, lunar, and planetary motions and relative topics. He has also discussed the rotation of the earth and has given correct values of latitudes and longitudes of various places. They were aware of the procession of the equinoxes, and discovered the slight movement of the apogee of the sun and they perceived the variation in the obliquity of the ecliptic. They discussed the possibility of the earth rotating on its own axis, but generally rejected the theory. They fully realized the necessity for methodological observation, and in practical astronomy; they excelled the Hindus and Europeans of their time.

3.2 Traditional Astronomy as a Profession in Bangladesh

According to the elderly traditional astronomers of Bangladesh, as a profession, it was never been popular and institutionalized in this land; rather very few folk feels an interest in studying the sky. Most of them are amateur. However, a number of Hindu Pundit (learned person) and Thakur (religious leader) are practicing astronomy in the traditional manner for their religious purpose. In most cases, they are performing in accordance to Bangla almanacs (normally Loknath or/and Nobojug directory panjika). It is evident from the study that, Hindu priests are many more skilled to ascertain favorable and unfavorable dates of the various occasions year wide. More to say, moderate Muslims as well as other religious people also rush to visit them while facing various social and customary problems (viz. House making, barrenness removing, getting jobs, marital purpose, foreign visit issue, and so on).

From the contemporary scientific perspective, this profession may mark as pseudo and may

Case-3.a: Traditional Astronomer at Urban Area

Sri Sharma Proshad*, 71 is an elderly educated person. He attained the knowledge and learned various skills from his Meso-Moshai (mother's sister's husband) in early age. His ancestors were merely cultivators, without any definite reason he stated his mind to get traditional astronomy as an occupation. He is practicing astrology and astronomy for almost 45 years. His chamber and residence both are situated at the heart of the city. He sits in his chamber at around 8 am and it continued until 10 pm sometimes more than that. Monday is a holiday, though some exclusive clients get entrances if he is available in this day. He feels proud as he makes the horoscope of present prime minister of Bangladesh government. People from different castes, classes, religions, and communities came to visit him from nearby and far-reaching places as well. His wife and sometimes youngest daughter, who is interested in this profession, act as receptionist of the chamber and gave serial numbers for the visiting clients. He is satisfied as there is no familial barrier, rather members of family are very much helpful and they also inspire him at any condition. Usually, he receives 1000/= taka as a visiting fee; the amounts increase for the rich if the problem seems very complex and time consuming. For the poor people he offers free services and never demands anything. He carries a cell phone and uses the land phone in the chamber, and for rapid service, he has to use a courier and e-mail. At least 50 middlemen work with him; few of them are pretty close to him and always try to keep everyday contact. Stone and gem-sellers of the city try to comply with his orders and never acts against him so that he refers the clients to them for necessary gems and stones.

Mr. Sharma keeps diaries as a documentary of past experiences and in spare time reviewed them. He keeps them handy and bring out if needed. He measures the movement of planets and stars mathematically and takes help from Vedha and almanacs. Giving answer of a question he opines (in an informal interview to the researcher 10 August 2013), "Joy and sorrow comes by turns. Similarly indications of planets and Rahu prevailing."

**Name used in this paper is pseudonym in order to protect the identities of the participants*

raise thousands of questions challenging its validity. Even though, there are no means to disagree worthlessly its social contribution; moreover its existence for long time witnesses that there remaining some aspects in it, which can be scientifically validated (some explanations are given in chapter-6).

3.3 Working Places of Traditional Astronomers of Bangladesh

Usually astronomical phenomena exist in the areas where watches are not widely used for time reckoning. It is evident in the case of older generations who have not or cannot determine time using clocks. They feel comfortable to reckon time by means of observing the sun at day and the moon or brightest stars (like Orion, Ursa-Major, and Polaris etc.) at night that is quite surprising compared with the prevailing IT age. Astronomical predictions are prevalent predominantly in Hindu inhabited areas. In the present situation, remote areas are the sanctuary for traditional astronomers, where the mass media (for example, different newspapers, radio, television, cell phone) etc. have not arrived or yet proves to play an influential role. From these views, it is revealed that most of them are available in rural areas.

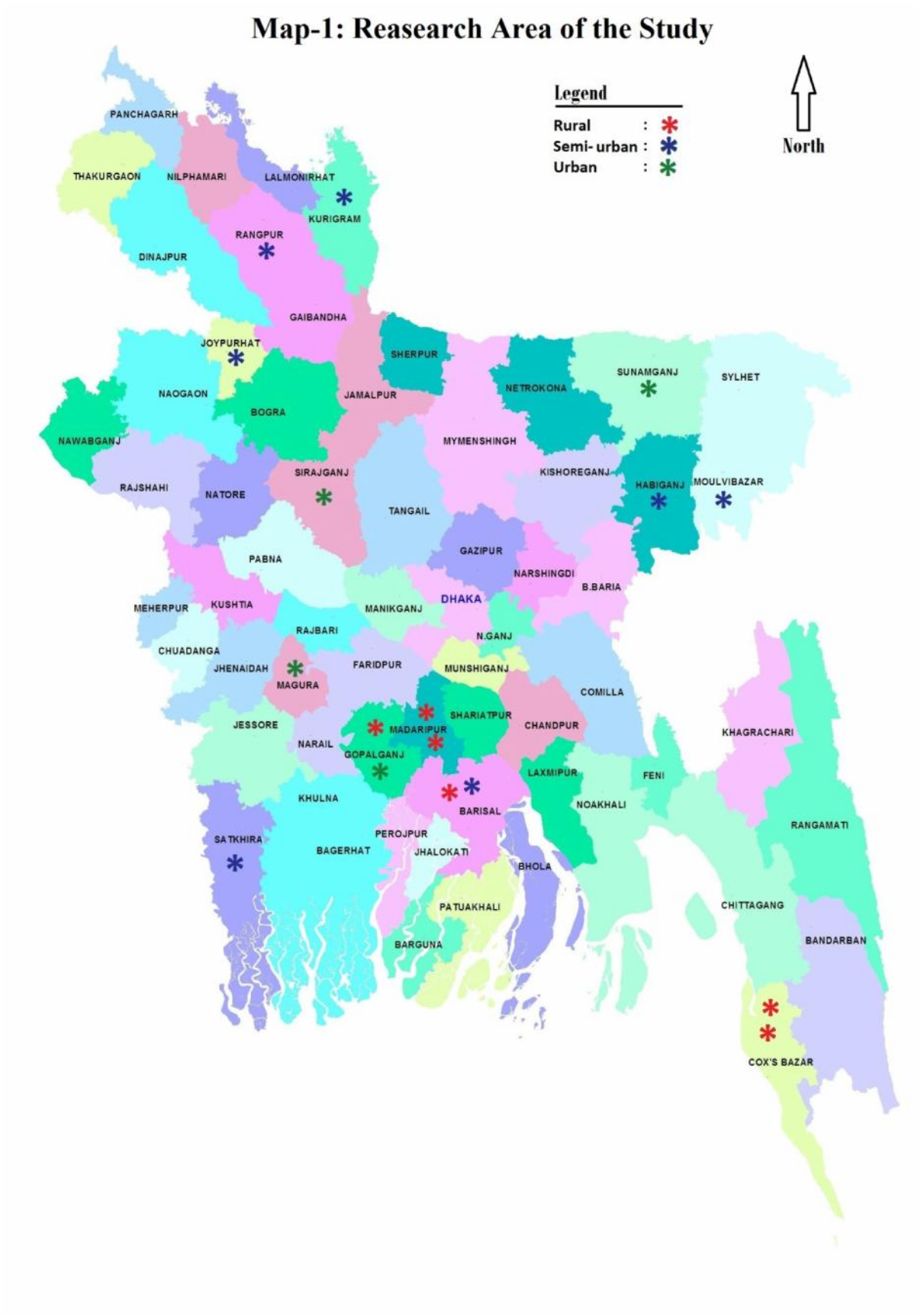
Besides, there are urban and semi-urban traditional astronomers as well. An obvious distinction could be made between aforesaid two categories. Urban and semi-urban traditional astronomers who are very much commercial than those of the rural. But both practices more or less same functions. Names of some observed areas are noted hereunder-

TABLE-3.1: Working places of the Traditional Astronomers of Bangladesh

Serial No.	Observed Village/Town	Union	Thana	District	Types of Working Place
01	Bagmara	Polash	Bishamborpur	Sunamganj	Rural
02	Bamrail	Batazore	Gouranodi	Barishal	Semi-urban
03	Basudebpur	Basudebpur	Muksedpur	Gopalganj	Rural
04	Chor-Gobindapur	Pachgaci	Pachgaci	Kurigram	Rural
05	Enayetpur[5]	Enayetpur	Enayetpur	Sirajganj	Urban
06	Ghuniya	Fasiakhali	Chokoria	Cox's Bazaar	Rural
07	Gopalpur	Gopalpur	Mithapukur	Rangpur	Semi-urban
08	Jatukornopara	Jatukornopara	Baniachong	Hobiganj	Rural
09	Joldaspara	Malumghat	Chokoria	Cox's Bazaar	Rural
10	Jhutitala	Laskorpara	Satkhira	Satkhira	Semi-urban
11	Kornygram	Rajnogor	Rajnogor	Moulavibazar	Rural
12	Notunbazaar	Notunbazaar	Magura Sadar	Magura	Urban
13	Paschim Baligraam	Baligraam	Kalkini	Madaripur	Rural
14	Paschimparh	Sikirbazaar	Kotalipara	Gopalganj	Rural
15	Shashikar	Shashikar	Kalkini	Madaripur	Rural
16	Thakurmallik	Sorikol	Babuganj	Barishal	Rural
17	Uchai	Uchai	Pachbibi	Joypurhat	Semi-urban

Beside these, there are a number of other areas of Mymensing, Jamalpur, Dinajpur, Noakhali, Chittagong, Bandarban districts. Existence of traditional astronomers are common at the rural and Hindu or sanatoni-Hindu dominated areas.

[5] Enayetpur is the location of Sirajganj district under Rajshahi division. The opening ceremonies of the International Year in Astronomy (2009) held at Enayetpur High School in April 2009. Astronomy related events held annually in this urban area.


Map-1: Reasearch Area of the Study
Legend
Rural :
Semi- urban :
Urban :
North
PANCHAGARH
THAKURGAON
NILPHAMARI
LALMONIRHAT
KURIGRAM
RANGPUR
DINAJPUR
GAIBANDHA
JOYPURHAT
SHERPUR
NAOGAON
JAMALPUR
BOGRA
NETROKONA
SUNAMGANJ
SYLHET
NAWABGANJ
MYMENSHINGH
SIRAJGANJ
KISHOREGANJ
HABIGANJ
MOULVIBAZAR
RAJSHAHI
NATORE
TANGAIL
GAZIPUR
PABNA
NARSHINGDI
B.BARIA
DHAKA
MEHERPUR
KUSHTIA
MANIKGANJ
RAJBARI
N.GANJ
CHUADANGA
JHENAIDAH
FARIDPUR
MUNSHIGANJ
MAGURA
COMILLA
SHARIATPUR
JESSORE
MADARIPUR
CHANDPUR
KHAGRACHARI
NARAIL
GOPALGANJ
LAXMIPUR
FENI
KHULNA
NOAKHALI
BARISAL
RANGAMATI
SATKHIRA
PEROJPUR
BAGERHAT
JHALOKATI
BHOLA
CHITTAGANG
PATUAKHALI
BANDARBAN
BARGUNA
COX'S BAZAR

Case-3.b: Traditional Astronomer at Semi-Urban Area

Borun Karmakar*, 62 lives separately from his Vitabari in a semi-urban area. He has been practicing the profession for about 28 years. At first he was an amateur gradual he came in the present position by his own interest. He is a self-educated astronomer and do not have any family background about the matter. From the beginning his father discouraged him, creates obstacles and interdict to think further, but at last defeated by son's determination.

Clients and patients often visit and consult with him regarding their everyday problems. Actually, it is not yet smooth going; people from surrounding do not hesitate to criticize him. He has a mind to shift chamber elsewhere. He is holding fame and reputation and that is why other people becoming zealous. However, Mr. Borun has employed an assistant, who helps him in maintaining discipline and in the collection of visiting fees. The assistant is his sister-in-laws husband. Borun pays his assistant 100/= per day and some other facilities, viz. Free accommodation, free tea, cigarettes, and betel-leaf, etc. during the job hour. Clients, who are powerful, in this area take prescriptions without any hesitation, leave the chamber by saying that s/he will pay the fee later. In the worst case, he has to go to client's door to collect the dues. It is obviously unbearable and that is why he depends on agriculture.

According to Mr. Borun (informal interview to the researcher 21 July 2014), rural astronomy is losing its glory day by day; its highest suing observed in the pre - liberation period. Nevertheless, after independence old tradition concealed gradually and it is nearly dead at present. Since the majority Hindu dwellers migrated to India, this occupational group decreased remarkably. Yet, who survives is living in miserable condition.

**Name used in this paper is pseudonym in order to protect the identities of the participants*

Earlier there was a number of visiting fore-tellers who roamed from house to house for preparing horoscopes. In those horoscopes zodiac name, marriage matching, probable death causes, number of begetting offspring, property achievements etc. were foresighted. The poor villagers who work hard to change their fate cordially received them. Later on, keeping pace with rising competition with modern technology fortune-tellers are declining. Besides, devoted Muslims avoid coming into contact with such traditional astronomers for the religious taboo. Mere reasons are Muslim rules and regulations discourage such prophecy largely. Therefore, traditional astronomy failed to expand widely in Muslim dominant rural Bangladesh.

3.4 Observational Equipments and Prediction Tools of Traditional Astronomers

For easy discussion, we are referring to equipments and tools together with the term instrument. Instrumentation has been developed in astronomy so that the data provided by the observations might be objective and would be no longer subjective. As in other sciences, the application of instrumentation immediately revealed that the scope of measurement is also extended. For example, when Galileo employed the telescope for astronomical observation, a new range of planetary phenomena was discovered and the number of observable stars was

greatly increased. Since Galileo's time, the whole range of observable phenomena has continued to construct with the application of each new type of observing equipment.

There are numerous objects and events that proves the assumptions that the heavenly body is well-known to the traditional astronomers in Bangladesh, and they widely understood well before the arrival of any natural disaster, like-cyclone, heavy rainfall, and hail storm. The travels of constellations, the phases of the Moon, the rising and falling of stars, solar and lunar eclipses, the appearance of comets, the colors of the clouds, the emergence of the rainbow, and many other astronomical phenomena were usually examined by them. This wide astronomical awareness resulted in the rural Bangladesh for having a precise understanding of the seasons and helped the rural peoples of the Bangladeshis to cultivate, navigate, and other livelihood dynamics. Traditional astronomers use some tools and techniques for prediction purposes. They are used merely geometrical figure, mathematical equation, and 'chunga'. Very few of them are familiar with the applications of the telescope. In this section, an effort is taken to give a brief description on various instruments that are everyday means for astronomical predictions.

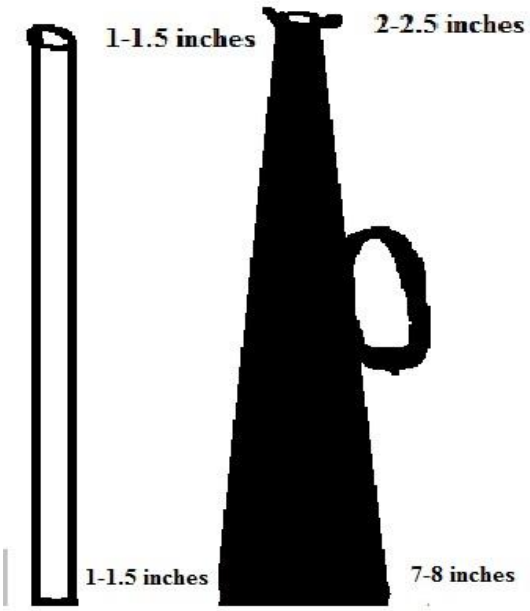


FIGURE-3.1 Two types of 'Chunga'

a. Chunga*:* Chunga is a telescope-like instrument used to seeing sky by the traditional astronomers. In rural Bangladesh, the researcher has experienced two types of 'chunga'. The first type is a cylinder made of wood or bamboo, 1-1.5 inches in diameter and 2- 2.5 feet in height (See figure- 3.1). The second variety is usually made of tin or metal. It is also cylinder-shaped and usually 2- 2.5 feet in height, one side narrow (2-2.5 inches diameter), the other side wide (7-8 inches diameter).

Sometimes, it is coated with black color so that the nearby light cannot disturb. For its low cost and easy carrying privilege, this tool is a common use for them. It helps to focus or concentrate on a certain portion of the sky. Traditional astronomers generally apply it to observe small stars in the apparent manner.

b. Telescope: The traditional astronomers rarely use modern telescopes to study heavenly

bodies, as they are not available and the cost involved with it is not bearable to them. In the present study, it is an interesting finding that most of them are unwilling to spare money for this purpose. A very few traditional astronomer who came in contact with modern astronomer use this instrument to observe the mysterious stellar sky.

The telescope is a far-reaching tool by which one can be impressed to see the outer space more clearly. There are mainly two types of telescopes- optical and radio telescopes. Optical telescopes are used for visible light and radio telescope collect and focus radio waves. Traditional astronomers, in general, use the optical telescopes.

c. Star Maps and Catalogues: The stars are not randomly distributed in the sky, rather it is worth to see by the way that the stars are grouped together. The star names and maps that were used in Bangladesh is a mixture of Ancient Greek, Arabian, and Indian astronomy (see Chapter-6, in 6.7 identifying different sets of the stars). The Greek system devised by world-famous astronomer Bayer in 1603 and after these, British astronomer Flamsteed, by universal consent, catalogued almost 3000 stars by the numbers (published in 1725). However, like other astronomers of different parts of the world Bangladeshi traditional astronomers are also familiar with equatorial stars (see appendix-4), the difference is that they give emphasis on the constellations that are named after different zodiacs.

Rough estimates of larger angles between stars, so providing the impression of just how large an area a particular constellation covers, can be made by using the 'hater maap' (measurement of hand) technique as practiced by traditional astronomers of rural Bangladesh. If the arm is fully extended, different parts of the hand can be used to provide some simple angular values. Typical values are indicated in figure- 3.2 but a system and the scale should be developed individually by comparing observations with a star map. In the first place, it will be noted that the angular extent of Ek-angul (the index finger) at arm's length is about $\sim 1.5^{\circ}$. This means that different constellations that appear at the same time in the sky, their distance from one to another could be easily measured through a view by the use of bare hand only. Thus, the distance from the Orion to the Taurus or from Polaris to Gemini could understand easily. Over the course of a few weeks, Traditional astronomers make it happen by taking note of the changes in rising and setting times of the constellations. This can be done by noting the times when a particular group of stars is at the same position in the sky seen from some regular observing point. Figure-3.2 indicates that the angular extent of 'Ek-muth' (the knuckle-span) is about $\sim 6^{\circ}$ and extent of 'Ek-bighat' (the full hand-span) is about

~13◦. Obviously, these values may vary from that of modern astronomy but it gives us a thought how local people are measuring the positions of celestial bodies.

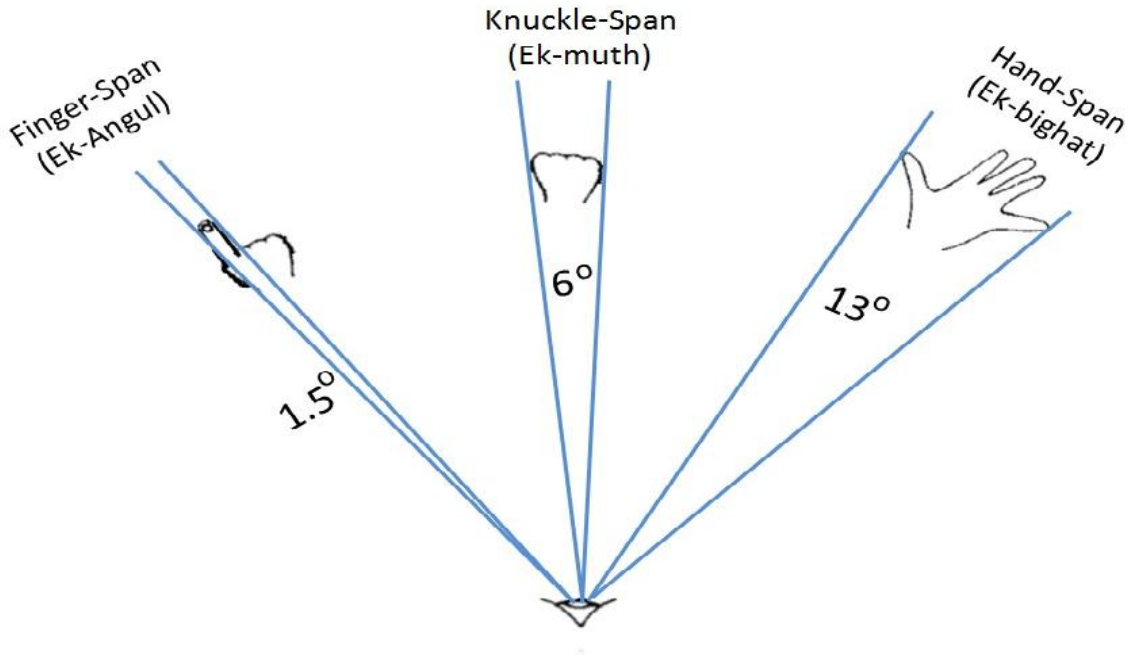


FIGURE- 3.2: Use of hand for estimating degrees/angles

In the southern hemisphere, more bright stars are found than in the northern hemisphere (Roy and Clarke 2003: 38)

d. Formulae and Equations: Traditional astronomers use a number of mathematical formulae and equations to study various social phenomena. It is astonishing that these are orally transmitted from 'Guru' to disciple and there is no single person who keeps written record. Some of the formulae can be noted here-

i. For predicting the price of various agri-products the following formula is used-

◯ +⯎ + ▲ +A÷3= answer and remainder

Where, ◯- stands for questioned month's lunar day

- ⯎ Denotes number of nakshatra (star)
- ▲ Symbolizes weekly day's serial number
- A Refers number of alphabets found in the concerned product

If the remainder comes '0' (zero) then the price of the questioned product will be high, the

remainder 1 (one) indicates it would be cheap, and 2 (two) refers to price unchanged.

For example, if someone feels interested to know the price of rice in any given month. First, he should reckon the lunar day, suppose it is 15; Nakshatra will be 'Chitra' that stood serial number 14; weakly it is Wednesday which position is 3; rice's alphabet number is 4. Putting values for each symbol now we can calculate by using the formula-

(15+14+3+4) ÷3= 12, and the remainder is '0'

In this context, traditional astronomer can predict that price of rice will be high. Why 3 divide the summation? In reply, of the question the pundit said that the enumeration of price measured by considering three astronomical aspects (viz. Solar, lunar, and sidereal), that is why the denominator is 3.

ii. If we want to measure the daily 'Dasha' (Planetary Influence) phase of a person, the following formula can be helping hand-

▲+○+☼+⯃÷8= answer and remainder

Where, ▲ - stands for weekly day's serial number

- ○ Denotes questioned month's bright fortnight
- ☼ Refers number of Janmo-nakshatra
- ⯃ Symbolizes number of nakshatra

If the remainder comes '0' or '7' then it is the indication of 'Shukra Dasha' that means happiness and affluence. Remainder '1' indicates 'Surja Dasha' which results property loss; '2' refers 'Chandra Dasha' that causes, earning money, '3' denotes 'Mongal Dasha' which causes the blow of a weapon; '4' denotes 'Budha Dasha' i.e. act of earning money; '5' indicates 'Shoni Dasha' which results having evil or foul design, and the remainder '6' indicates 'Brihaspati Dasha' that causes the act of earning glory. Variations of time, space and Dasha have a great impact on the result, eg. For the poor same money earned instead of 'act of earning property or glory'.

Note: The result remains in fullest measure until the end of the enumerated lunar day. The prediction will not work after passing lunar day; then it is needed to make further new one. Why 8 divide the summation? In reply, of this question the pundit said that the daily Dasha is reckoned by considering 4 astronomical aspects and since it is a 2-way journey (from man to astronomical aspects, and vi's-à-vi's), 4 multiplies 2 and it comes 8).

e. ***Geometrical Figures:*** Traditional astronomers of Bangladesh also follow some geometrical figures for prediction; two of them are-

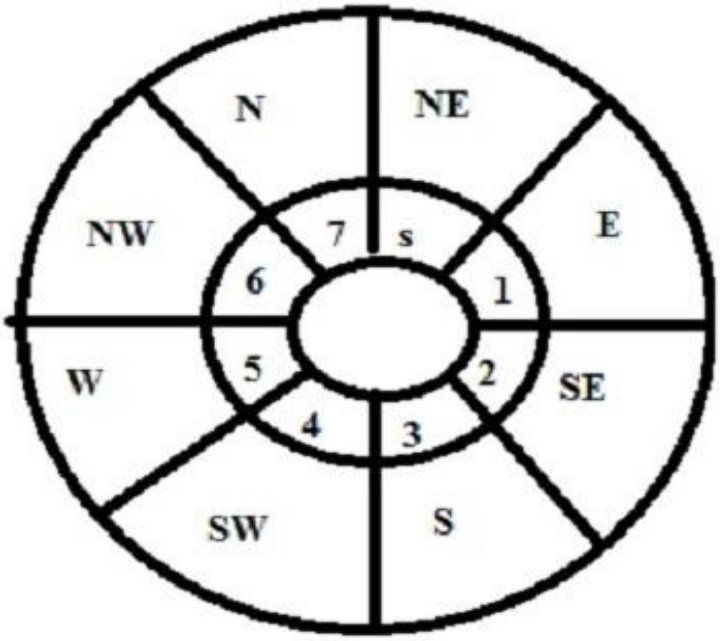


FIGURE- 3.3: Zoagini Chakra (Circle)

i) **Zoagini Chakra:** This figure is known as 'Zoagini Chakra' (Circle of particular conjunction of the stars). It is acting as a guideline of the favorable and unfavorable journey. On the first and the ninth lunar day of a month 'Zoagini' stay in the East, on third and eleventh lunar day it exists in the South; on the fourth and twelfth it stays in the south-west; on the sixth and fourteenth 'Zoagini' exists in the west; on the seventh and full moon day this place in the north-west; on the second and the tenth lunar day it places in the north; and on the eighth and new moon day Zoagini stays in the Northwest.

Traditional astronomers give prescriptions that one must leave off the last nine Danda (=24 minutes) after Zoagini. If one begins journey when Zoagini is staying in front or southern side, it is unfavorable time. Contrariwise, Zoagini's staying on the left and back side, symbolizes favorable time. Thus, traditional astronomers can be called social doctors for their performance at the local level.

ii) **Pataki-Chakra**

It is a circle drawn for ascertaining the good and evil by the traditional astronomers. It is too easy to make-- first one should draw three straight lines, then more lines crosswise lastly one should attach the points by curved lines. After making the desired picture- 5, 8, 2, 20, 6, 10, 14, 3, 4- these numbers should be distributed among the nine rashis (from Cancer to Pisces).

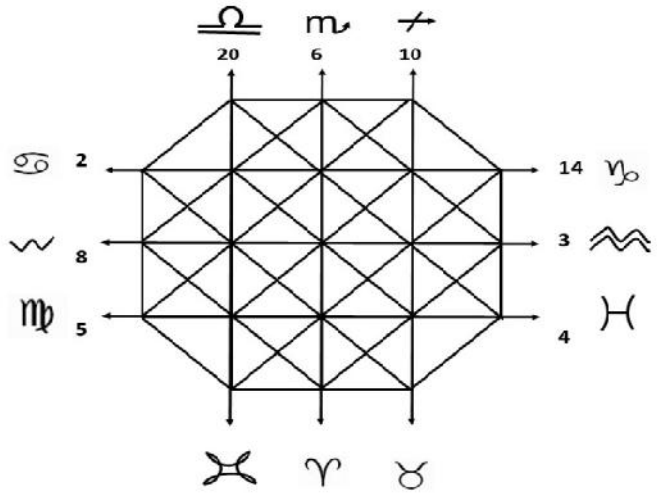


FIGURE- 3.4: Pataki Chakra

If the 'bedh' (perforation) occurs between the rising time of any zodiacal sign and the favorable Danda, it indicates good fortune. On the contrary, 'Bedh' between 'Logno' and evil danda indicates misfortune. The rules of Bedh are- Cancer's perforation with Gemini, Pisces, and Sagittarius. Leo's perforation with Aries, Scorpio, and Aquarius; in this way the total number's day, month, or year is the time of evil planetary aspects. For example, the head of Leo (=8) as tied with Scorpio (=6) and Aquarius (=3); the total comes 17. This is the indication that on the 17th day, month, or year the man will suffer by evil planetary aspects.

3.5 Assessment of Traditional Astronomer's Professionalism

Professionalism is not easy to recognize, and not easy to define as well. Profession is a fulltime occupation and is something special than that of job and business. The truth is that there are as many great professions as there are great professionals. Comparing with other professions astronomying is not so prestigious but it possesses some value as well. A competent and committed traditional astronomer is in need for a fatalistic society like rural Bangladesh. Professionally committed traditional astronomer has been identified as one of the most crucial factor for the success of rural society. It is closely related with the work performance and other adjoined features of the very astronomer. Hung and Liu (1999) depicted that stay-back is the factor, which is most highly and significantly related to professional commitment. Apart from this, the other factors like marital status, age and tenure were also found to be significantly related to professional commitment. Shukla (2009) demonstrated a high positive relation between professional commitment and job satisfaction

but the relation between teaching competence and job satisfaction came to be positively very low for most of the dimensions and for some of the dimensions, negative relation was observed.

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A traditional astronomer is a friend of local people; he is like all other good-doers. Most often he is poorly paid, sometime unpaid, but serves everyone with a smiling face. Traditional astronomer has been preferred to be in the village, and lives there like an inhabitant. He can be called a villager; he has no laboratory for research work, and no library for study. Simply, keeping similarity with other villagers he also suffers from distress and poverty, want and misery. His thirst of learning fulfilled environmental experiences and natural calamities. He examines clients and patients in a homely atmosphere with his own tools and equipments, and visits them when required to do so. In fact, he is an institution by himself. He loves and enjoys his profession, as one of them explained:

> "My profession is my power, my passion, my root and everything that holds my dignity. [It] gives me strength; the profession is my identity, who I am. My profession gives me pride. The profession is my love and worship."

Traditional astronomer is not a recognized specialist; he is not always very skilled in modern

science. Even then, he is a dedicated servant for the mass people. He knows his patients and clients individually, and is aware that their sickness is not merely medical but also social. He can, therefore, treat them like friends and neighbors, more to say as a social doctor. He is always available for consultation. Being an educated person, he has a divine tendency to enlighten people. His chamber is also a center of cultural practices and sound entertainment where surround people meet for discussion of local, national and international affairs.

It should be mentioned here reasonably that there are a number of fake traditional astronomers. They have too little but try to express far than that; they are quacks and very much commercial, sometimes advertise in mass media praised by themselves and subdued middlemen. Blindly it can mark that for their cheat this traditional profession gradually losing its acceptability, credibility and temperament.

Chapter Four

Social Aspects of Traditional Astronomers of Bangladesh

Social Aspects of Traditional Astronomers included the network of relations existing among the individuals and society. Under this heading mutual relation and obligations, religious activities and beliefs, groupings and factionalism, and such important social aspects were elaborately discussed. A descriptive approach has been given to unfold the social welfare, social control, and future generations' thinking among the traditional astronomers of Bangladesh.

4.1 Traditional Astronomers and Their Family Life

Having similarity with a majority, the traditional astronomers of Bangladesh are now practicing nuclear family. A joint family may break down into a number of families, but the control over property may remain joint. Sometimes religious rites and festivals are also observed jointly by a number of traditional astronomer families that are genetically related. The families of them under study are mostly monogamous, while a small fraction of them, mostly of the older generation, practice polygamy.

As this profession is about to extinct, the parental attitude, beliefs and rules of conduct have changed in such a way that there is little agreement among parents as to the course of conduct their children should pursue. The existence of the traditional values nurtured by the old generation is facing the threat of demise. The following generation who come to the urban areas for various purposes, loses almost all traits of their traditional values. However, the family still has some degree of responsibility and control over the young ones, cultural values in shaping their habits, moral attitudes and social organization is getting increasingly difficult to uphold the traditional values of the following generation. The tradition of rural to urban life caused radical changes in the family control over the young generation.

Among the traditional astronomer parents concern about the achievement of their children is quite normal. In the villages under study, the highest concern of the parents has been expressed for general and astronomical education in respect of sons and for good housekeeping in respect of daughters. They have considerable concern about achievement of their offspring in education and service (for sons) and in good house management and character (for daughters).

For traditional astronomers the pattern of the family as such in rural Bangladesh is going towards a definite form. The control of the parents over their married sons is still dominant that represents all the characteristics of joint family except their separate hearth.

4.2 Social Welfare and Social Control

Traditional astronomer's social welfare works are mainly concerned the problems arises among the people. People from distance side by side nearer came to visit with him and follow his guidelines to solve the problem. Problems are chalked out hereunder-

i) Diseases;
ii) Marriage matching;
iii) Unemployment;
iv) To remove unfavorable time;
v) To get offspring;
vi) Business sector;
vii) For going abroad;
viii) Weather forecasting and agriculture;
ix) Direction reckoning for house making;
x) Horoscope making, etc.

With the aforementioned issues if any other subjects came under solving, then traditional astronomer works. Most of the times he suggests oral or unwritten prescriptions. Sometimes he takes the help from supernatural power. The traditional astronomers have to perform another type of social welfare activities. Most of them do not ask money from very poor villagers, though they do only what they can do with their manual instruments and prescribe medicine but they do not give free medicine to the ill patients.

It is more or less known to all that in village level, there is no elected official committee of management and as the administration of the village. The aged male member sometimes-traditional astronomers of the village and a few from outside villages like- the UP chairman and members took the decisions. Moreover, when a person has control over the village due to his sources of power in the social structure of the village provides with a new sources of power are- age, profession, land ownership, belonging to large kin group, connection with the political parties, leadership in the local government and religion.

For the professionalism, traditional astronomers are honorable people to mass people.

Villagers respect them and treat as a scholar. At various social festivals, they are regular for

the invitation. Sometimes any of them can preside over the social meeting. Economically, they are not very powerful rather than merely influential persons. Inhabitants of the surrounded villages call them in *the Salish* (Informal body of political organization) and *Mimansha* (settlement outside court) and it is mentionable that villagers show respect to their verdict. Alongside with aged people, young generation obey traditional astronomers. By this way control over society ascertained.

4.3 Religious Beliefs and Festivals

In this study it has been found that the traditional astronomers mostly belong to the Hindu community, though Bangladesh is a Muslim dominated country. A strong reason for this may be cited from Muslim's beliefs. Prediction of human fate is treated as to make 'Shirok' (substitute of Allah). Besides, there is no such restriction in Hindu religion. Alike other Hindus, traditional astronomers say their prayer, *Puja* (worship) - *Purbon* (rituals), sacrifice animals. They try best to celebrate gorgeously *Durga, Kali, Laksmi,* and other remarkable *Pujas*. Parents always try to pay children's demands of new dresses and to make special food on the occasions. Decorative lights glitter inside the rich house, middle-income lit lamp or candle in almost every house, adding to the grandeur. In any *Puja* the festive mood is visible from the morning to midnight in accordance with traditional rituals.

There are some religious beliefs and activities are observed centering the chambers of traditional astronomers. In the evening, they burn *Dhup* (a kind of powder that make perfumed smoke), but as the burning of *dhup* become costly now a days, so they are now purchasing *Agarbati* (a kind of stick that make perfumed smoke) instead. In all the chambers, at least one photograph of their God, sometimes two or more are seen. These photographs are adorned with flower in the morning and the homemaker daily accomplishes this work.

Most of the traditional astronomers are the follower of Sonaton (Original, true and actual Hinduism) religion. They are now identifying themselves as Sonaton Hindus, and celebrate different *Pujas*. They celebrate following *Pujas* in a year.

Table-4.1: Different Pujahs in a year

Serial No.	Name of the Puja	Time	
		Bengali month	English month
01	Baishakhi Puja	Baishakh	April
02	Gram Puja	Jaishta	May
03	Dal Puja	Vadra	August

04	Durga Puja	Ashwin	September
05	Kartik Puja	Kartik	October
06	Laksmi Puja	Kartik	October
07	Kali Puja	Kartik	October
08	Atkura Sankranti	Agrahayan	November
09	Loban Puja	Agrahayan	November
10	Paush Sankranti	Paush	December
11	Shareswati Puja	Magh	January
12	Ganesh Puja	Magh	January
13	Sib Ratri	Chaitra	March

There are several other smaller festivals, which are associated with rituals; such as the naming of a newborn child, *Annoproshonno* (Hindu rite of allowing a child to taste rice for the first time), ear-boring, marriage, *Sraddha* (funeral ceremony) etc. the villagers with great care and attention observe these. Friends and relatives are invited according to the economic ability of the individual family. First preference goes to the members of one's own *Bari* (homestead). Then he invites other neighboring villages. However, he must invite Sardars, *Matobbars* (informal leaders) and *Murubbis* (Elderly persons of the villages) etc.

4.4 Grouping and Factionalism

The main grouping found among the traditional astronomers is between commercial and non-commercial; in some cases the same is observed between guru and disciple. For the second one mortified at another's good and prosperity. Among the commercial traditional astronomers this exist densely, most often one tries to disclose the weak points of another to the client i.e. each of them demanded own supremacy. Here it should be noted that intermediary are a major determining factor. Active intermediary can easily make one's chamber crowd—if the astronomer has little fame and influencing power. There are no visible conflicts or quarrels rather, it's a cold war to make long lines of the client.

It is interesting that grouping also available among the clients, are devious grouping found between Hindus and Muslims. For being majority Muslims think that they have the capability to ignore the Hindus, they demand more concentration of the social doctors (traditional astronomers) and well treatment than the non-Muslims did. On the contrary, Hindus do not agree to give any kind of space. Since the traditional astronomers belong to their community, they also demand full concentration and precise treatment. In the discussions and gossips take

place everyday under the shades of tea-stalls and the participants are generally the Muslims and sometimes Hindus expresses their anger and hatred towards the adverse community. However, a traditional astronomer most of the time manage to maintain a harmony and in a friendly manner.

4.5 Future Generation's Thinking Regarding the Profession

In the study, it is found that the following generations of traditional astronomers are mostly unwilling in continuing the present profession. In most cases, it is noticed that the sons of these professional wants to start a new business of their own and they want to start something different from their future generation. Few of them want to continue the same occupation. Education for them is just something what they do nothing to get from it as they think. Most of the young of traditional astronomers think that they will not get any good job, and they also think that it is easier and profitable to do business rather to find jobs. Money can buy anything even power and status, as they think with regret. Although they show respect to highly educated persons and often talk about them with proud as they are from of, if any, the village where they live, but they think that they will not be able to reach such position as they are the sons or daughters of traditional astronomers. When they might get reminder that those of whom they talking about are also from some of the same status family, they commented that those were exceptions, and exception should not be drawn as ordinary example. And they also add (informal interview to the researcher 22 October 2014) about how hard task it is to get one educated and easy it is to earn money doing business. In addition, they are not used to grow with the educational environment, as such education becomes hard and sometimes almost impossible work to be done. Their parents also insist the young generations and if no barrier is made and no inspiration is given to continue further study in a serious manner. Moreover the poor villagers prefer to let their children do some works which in their view have immediate economical benefits. To them education is an optional thing to be done, especially this thing can be observed in working season when fathers are either accompanied or found to be helped by their children in their harvesting fields. This is the common feature of rural people, reasonably traditional astronomer's sons/daughters fail to think further better. Among the small bulk who wants to continue father's profession, relationships between father and children do not always remain merely kin-based, even sometimes the relationship become something more than kinship, in the form of partners. Sometimes new visitors who do not know the relationship might get confused and most probably may think that relations

are of an employer and an employee. Those who do not economically sound do not pay anything for their son's labor. In case of middle-income family children sometimes, get some payment for their industry in the form of pocket money. In search of why the adult sons of solving business continue to work with father sometimes even after they live separately with their wives, is observed that it is mainly because they have interest on parental property. And also because it is easy to continue familial profession, as it is easy to continue as they already know the rules, the related people, etc. They do not have to invest a lot, and sometimes even nothing at all; and this selection of profession is comparatively secured than others.

Constructivist Piaget's book A Child's Conception of Space (1967) deals with the development of the child's notion about space. In this book, investigations have been concerned with the order and manner in which children begin to imagine or visualize the various spatial entities and spatial characteristics of objects. However, the present study observed that the new generation imagines that the 'traditional profession' is good, but visualizes it as unsuitable for mere subsistence. Those who continue to run father's profession usually wanting to prove his acceptability side by side to prove his betters, and some are found who expanded the profession and also diverted it to many subsidiary businesses. Some cases are found who is carrying the absolute type of profession their father, grandfather, or in rare cases of their father-in-laws used to do.

Chapter Five

Economic Aspects of Traditional Astronomers in Bangladesh

The economic organization of a community refers to the institutional and functional involvement of the people focused on the activities associated with the satisfaction of material needs of the people. Every practitioner has its own way to manage the basic needs. Traditional astronomer's basic needs are conditioned by natural and social-cultural factors as well as by the level of technology available and in practice.

Traditional astronomers are economically associated with middleman, clients, and stone-supplier. Most of them are indirectly involved with agriculture, teaching, healing, farming, harvesting, business etc.

5.1 Consultation Fee

Fee for consultation is one of the major in the economic aspects of traditional astronomers. Alongside agriculture and cattle rearing, it is a foremost income source for them. Though traditional astronomer's fee differs from each other, in nature of the problem, and sometimes for his fame and influence. Usually its limits from 500/= to 1500/= Bangladeshi Taka. Traditional astronomer, who is famous and influential, kept a receptionist in the decorated chamber. The receptionist accepts the money strictly on cash and maintains the serial number of the clients. More to say, it is a micro-commercial unit and so there is a chance for some people to be deceived by the quacksalver. This happens in case of urban and semi-urban areas; but when the researcher goes to the rural society observed quite different picture. The traditional astronomer lives in a tottering hut, needs are his daily companion. With great difficulty, he passes struggled life. Nominal visiting fee he gets from the client, indeed, it is the subject to one's desire. He does not use any middleman, and reasonably there is no need to appoint a receptionist. He has no chamber as well. He treats the visiting client with a homely environment. Sometimes, clients or patients come to meet him along with domestic fruits and roots or other edible items. He accepts those with warmth. It is not hard work to appreciate that comparatively rural astronomer is more nearer to local people than their urban and semi-urban counterparts. The consultation fee is not so important to a rural astronomer, he conducts the work as his social responsibility. Besides, the whole fact expressed in the inverted image for the urban and semi-urban traditional astronomer.

5.2 Middleman

Case-5.a: Middlemen

Shukdev Kundu*, 28 is the eldest son of his parents who have eight children (seven sons and one daughter). Since he is the eldest and being the member of poor family, he has no choice but find out some sources of income. When Shukdev was studying in class eight, he has no way but stop education due to poverty, his father bought a 'dhop' (mobile shop) for him to start business in the nearby marketplace. His first investment was 600/= taka given by his father. For poverty, he has to stop education and start to run his mini-shop. He begins to contribute 150/= taka per week for his family and started to live in the shop at night. Taking loans with compound interest rate from Mohajon (money lender) Shukdev tries to extend his business for two times, but fails to do so as he has to bear the familial expenses. While depression piles up, he came in contact of a fore-teller. However, at last he was appointed with some conditions in the very fore-teller's chamber, who also practices astronomy. Shukdev was appointed to bring clients and in return will get 25% of the visiting fee. In the beginning, he hesitates and suffers from wavering in the mind. After a few weeks, it appears to him as easy work, and it helps to increase his income. He is enjoying the job and it seems profitable and comfortable; now he spent full time here and concentrates on the work of the Guruji. He has an ambition to learn the work from him.

For the last 10 years, Shukdev is doing this job. He is the trusted one to Guruji, he also wins the heart of the clients for faithful and positive attitudes. To the local people he is familiar as a dependable matchmaker. He settles almost 50 marriages by this time. In a repentant tone, Shukdev said (informal interview for the researcher 19 July 2014) that he earned more by this young age, but for immaturity, he spends all the money just for eating and enjoying. Apart from everything, he never forgets that he is the major earning member of a large family.

**Name used in this paper is pseudonym in order to protect the identities of the participants*

Middlemen are those persons who promise to solve any kind of problems or complexity by taking money from the problem-facing clients. These intermediaries, people maintain a good relation with traditional astronomers and other problem-facing persons of the society. In a word, they are the commercial-go between traditional astronomers and clients or patients from different income groups. This pseudo-class evolved for the competitive attitude of traditional astronomers (competing for the fame and influence). Middleman acts here as a helping hand in advertising mood. Sometimes a simple occurrence changes into fiction or myth with a mixture of exaggeration by which mass people may attract. While conducting interviews (from September to October 2014) one of the middleman stated that-

> "My Guruji can solve every difficulty by the wish of almighty. He is a man of wisdom, and that is why he can easily understand the problems by his intuitive and introspective view and solve it in a better way."

Usually most middlemen come from the surrounding areas of such persons who are long been involved with traditional astronomy. This system is rare in the rural but common in urban and

semi-urban areas. Middlemen are not needed to be highly educated, they go at best to high school level.

The fee of brokerage is a matter of negotiation, sometimes bargaining took place—the middleman receives fore-fixed amount from the traditional astronomers. It should be noted here that each of them does not get same rate, rather it vary from man to man. In an average 15% to 25%, money they get for each client's visiting fee. Active, clever, responsive, and most of all convincing qualities are the distinguishable variables to them. They are not many in numbers and most of them take it as a part-time job or seasonal activity. However, the middlemen are of good help to the traditional astronomers and side by side to the problem-facing persons.

5.3 Stone Prescriptions

In prescriptions, traditional astronomers often suggest wearing gems or stones in the finger ring; it is familiar with the name 'stone therapy'. According to them, it protects the wearer from evil impact and brings fortune. Businesspersons, politicians, various employees, patients, problem-facing people and traditional astronomer himself uses various gems. These gems are suggested for a particular cause like marriage, love-affairs, litigation, ill health, studies, fear, property loss, speculation, foreign trips, political elevation and general prosperity etc. Gems or stones are known as lucky stones, it is believed that these bring good luck and fortune for particular causes, mentioned above.

Stone therapy is a matter of the vexed question to mass people. Many complain that gems worn by them have not brought any visible effect. Supporting own position one of the traditional astronomer pointed out (informal interview to the researcher 23 August 2013),

> "Gems should be prescribed on the basis of complete calculation of horoscope wherein name, date of birth, time and place of birth is required."

For urban traditional astronomers gems supply is one of the main monetary affair of economic activities, all the stones are not available in Bangladesh; so they import it from abroad – especially from India, Sri Lanka, Pakistan, and Myanmar. A rural traditional astronomer refers their clients to jewelers and gem-sellers. As they are unable to invest money to buy precious gems, they cannot keep necessary stones with them. However, stones do not suit everybody; it depends on the ruling planets. Hereunder a table for suitable gems or stones-

TABLE-5.1: List of Suitable gems according to ruling Planets

Serial	Ruling Planets	Gems or stones	
		English name	Bangla name
1	Sun	Ruby	Manikya or Chuni
2	Moon	Pearl	Mukta
3	Mars	Coral	Probal
4	Mercury	Emerald	Panna
5	Jupiter	Yellow Sapphire	Padmarag Pokhraj
6	Venus	Diamond	Hira or Bajra
7	Saturn	Blue Sapphire	Nila or Indranila
8	Rahu	Cinnamon	Gomeda
9	Ketu	Cat's Eye	Nilamoni

Beside these, there are a number of other precious stones, viz. Amber, Jasper etc. that is also prescribed by the traditional astronomers.

Case-5.b: Male Client

Gobinda Biswas*, 52 is a senior school teacher, lives with wife, children and aged mother. His father was a Purohit, who is interested on traditional astronomy. From the father's inspiration, full family began to like the event and that results following generation are more or less weak in the matter.

In doing any promising work, he first goes to the Thakur for consultation. He always abides by the prohibition and maintains the favorable and unfavorable time. He is directed according to the judgment of Thakur. Gobinda Babu uses a cat's eye in his finger ring. He also formulated Kusthi-thikuji of his children. He suggested (informal interview to the researcher 13 November 2013) that every parent should make a child's horoscope as soon as possible through the help of an experienced Thakur. It is an obligatory duty of parents and by following horoscope instructions; a child can grow well, and can successfully attain its perfect destination.

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Case-5.c: Female Client

Moni Paul*, 36 gets married in the year 1985. She has one son and one daughter. Her husband is a NGO worker. In their conjugal life, they strictly follow the instruction of a famous Thakur. Before their marriage, the parents of both sides justify marriage matching. When the Thakur gives positive signal, they arrange the ceremony. However, Moni grows up in such an environment that possesses deep root of traditional Hinduism. From the adult age, she used to wear Cealon Gomedha stone in a finger ring.

She opines (informal interview for the researcher 25 December 2013) that by following the instruction of Thakur, it is quite possible to lead a comfortable life with endless happiness. She always obeys the prescriptions and counsels of the Thakur. She is conscious enough about her children and therefore constructed their horoscopes from the early age.

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5.4 Clientele Relation: The executives of different trading companies are trained for a few months about the clientele behavior so that the company can win the heart of the customer. However, the traditional astronomers have not received such rigorous training, but they are conscious about their role. They treat the clients as 'Laksmi' (good luck), since they are a major source of their income. For the time being a behavioral pattern structured which ties them nearer and thereby clientele relationship appeared. Mutual understanding is the fuel of this kind of behaviors. As the relationship does not bridge over night, the changing pattern (if any) is difficult to define; thereafter, the existing structure of clientele behavior among the traditional astronomers and the problem-facing people can be illustrated. In rural Bangladesh, the basis of relationship between the two is to some extent kinship centered. If both of them belong to same status group and almost of the same age, then they call each other by names or even nicknames. Nevertheless, if one of them is of higher status or belongs to aged group than terms of address changes. In this case, one might call the other as 'chacha' (uncle) and the other will reply in some similar kinship term, such as 'bhatija' (nephew) – in most cases such replies are observed in kinship based rural society of Bangladesh. Of course, this relationship could be marked as fictive kinship and this kind of relationship, make their conversation, more to say reciprocity easiest. And sometimes, it is observed that behaving in such way the traditional astronomers give prescriptions in a commissioned fee and supply gems/stones at a cheaper price to the clients with whom the fictive relationship have been established.

The above descriptions are of the rural image, but in the urban and semi-urban fictive relations are rarely established as middleman plays an intermediary role. Traditional astronomers behave with the clients politely. For the sake of client's comfort and safety he adorned the chamber with furniture and sometimes kept television for their entertainment, a receptionist always looks after the waiting clients. Major distinguishing feature between rural and urban traditional astronomers in context of clientele relations is that the first one conducted with clients informally and homely manner, whereas the last one treated clients by impersonally and formal behavior.

5.5 Subsidiary Occupations

Working pressure and business of traditional astronomers are not remaining same for all the year-round. An apparent view of prevailing rise and fall is also observed. Summer and rains are dull seasons, according to the traditional astronomers. Prominently dissension takes place between urban and rural traditional astronomers. The above statements are applicable for rural and semi-urbane whose monthly income is not enough to meet mere subsistence. To provide food, clothing and shelter for family members they look for alternative means of maintaining, as substitute occupation. They usually choose religious practicing, healing, teaching, seasonal business, etc. Apart from these, a great portion of their familial expenditure comes from homely vegetation, livestock rearing, milk business and production different crops. On the other hand, urban traditional astronomers are not taking any other alternate professions as they think it is adequate for them.

Case-5.d: Subsidiary Occupations

Ziten Chakrobarti*, 55 is a person of diverse qualities; successively he practices traditional astronomy, purohit kormo, homeopathy, and agriculture. He teases (informal interview to the researcher 25 September 2015) himself, "I am jack of all trades, but scholar of none!"

Although money comes from various sources but the total amount is too little for mere subsistence. Ziten himself cultivates land that he owned and produces paddy, pulse, sugarcane in the field. He is also a practitioner of homeopath. It seems that Mr. Ziten does not feel comfort to give information about familial facts and always tries to hide poverty. He has no chamber to seat formally, he asks with astonish, 'what I will do with chamber, it was needless to me'. If any problem facing family calls him, he directly visits there; sometimes his youngest son accompanied him. In return, he was paid mostly by kind not cash. Household necessaries like- vegetables, fruits and roots, and rarely domestic animals are popular items for payment.

Usually Ziten use to reckon household directions, Shraddho-shanti, Chandrayan, horoscope making, marriage matching, fore-telling, obsequies etc. He has busyness for all the year round, but even then has no wish to engage next generation in this profession. Adult Childs were no more interested on father's low-income occupation. He opines that 'public has meager trust on traditional astronomy. Fake astronomers cheat mass people and consequently they start to mistrust.

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Chapter Six

Ecology and Environmental Aspects of Traditional Astronomy

Ecology deals with the various principles which govern relationships between organisms and their environment. It is the science of relations between all living things and their surroundings. Ecologists use knowledge from many fields, including physics, chemistry, mathematics, and computer science. They also rely on other sciences such as climatology, meteorology, geology, oceanography, and astronomy to learn about air, land, and water environments. Likewise, traditional astronomy is concerned about earthly and heavenly bodies. They want to find relationships between earthly and heavenly phenomena. This chapter discusses about different aspects, viz. Time reckoning, housing plan, weather forecast, Agri-age determination, planetary indications, and different stars set identification, which show linkages between ecology and traditional astronomy.

6.1 Reckoning of Time

Time measuring is an important factor of the traditional astronomer for preparing horoscope, calendar construction and other related works. Bangladeshi traditional astronomers divide time into various units of lengths, which may be classified as—1) General; 2) Small; 3) Large; and 4) Specific. These may be discussed as

a) General units of time include Borsho (year), Ordho-borsho (half-year), Ritu (season), Mas (month), paksha (fortnight), Saptaha (week), Din (day), Prohor (quarter of the day/night time), Muhurta (1/15 part of the day/night time), Danda (1/60 part of the whole day) Pol (1/60 part of the Danda) etc. limits greater than a year or less than a Pol are not required for traditional astronomical measurement.

   There are four kinds of year; sidereal, solar or tropical, lunar, and luni-solar. The Nakshatrya Borsho (sidereal year), according to traditional astronomy, consists of 365.2563627 days or 365 days 6 hours 9 minutes 16 seconds. Usually, the year used in civil life is based on the tropical or solar year (Surya barsha) consists of 365.242196 days or 365 days 5 hours 48 minutes 47 seconds. The tropical year (of length 365·2422 mean solar days) is, therefore, shorter than the sidereal year. The lunar year (Chandra Barsha) consists of 354.3670581744 days or 354 days 8 hours 48 minutes 55 seconds. The luni-solar (Surya-Chandra Barsha) year is same as the sidereal year adjusted to the lunar year

by omitting an extra-lunar month recurring after 32 and 33 sidereal months in practice. The presently used calendar year is the Gregorian, just defined, and introduced by Pope Gregory in 1582. Previously, the Julian calendar had been used in which simply every fourth year a leap year of 366 days; February 29 was being the extra day. This gives an average value for the length of the civil year of 365·25 mean solar days. By 1582, the discrepancy between the number and the length of the tropical year (365·2422 mean solar days) had led to the considerable error of over 12 days. The introduction of the Gregorian calendar removed this error (Roy and Clarke, 2003:99). The half period of a year is called semi-year. It originally consisted of northern and southern periods. The period taken by sun to travel from the vernal equinox to the autumnal equinox i.e. as long as the sun remained north of the equator, was known as the 'debayana' (the passage of Gods) and the period taken by the sun to travel from the autumnal equinox to the vernal equinox i.e. as long as the sun remained south of the equator, was known as the 'pitriyana' (the passage of deceased ancestors).

Periods of different conditions in a year are called seasons. In Bangladesh there are six seasons, viz. Grisma (summer), Barsha (rains), Sharad (autumn), Hemanta (pre-winter), Shita (winter), and Bashanta (spring). Each of the above-mentioned seasons consists further of two tropical months starting from the day of the vernal equinox. Following table shows the duration of sidereal months comparing the measurement of Surya Siddhantika of Varaha Mihira and modern astronomy.

TABLE-6.1: The measurement of Surya Siddhantika and modern astronomy

Season	**Month**	**According to modern astronomy**			**According to Surya Siddhantika**		
		Days	Hours	Minutes	Days	Hours	Minutes
Grisma (summer)	Baishakha	30	21	17.6	30	22	26.8
	Jaishtha	31	6	45.2	31	10	5.2
Barsha (rains)	Asharra	31	10	45.6	31	15	28.4
	Shrabana	31	8	12	31	11	24.4
Sharad (autumn)	Varda	30	23	43.6	31	0	26.8
	Ashwin	30	11	44	30	10	35.6
Hemanta (Pre-winter)	Kartik	29	23	27.2	29	21	26.4
	Agrahayan	29	14	15.6	29	11	46
Shita (winter)	Pousha	29	10	31.2	29	7	37.6
	Magha	29	13	6.8	29	10	45.2
Bashanta (spring)	Falguna	29	21	18.4	29	19	41.2
	Chaitra	30	9	2	30	8	29
Total		365	6	9.2	365	6	12.6

TABLE-6.2: The lengths of the northern hemisphere seasons in the year 1999 to 2000.

Season	Days	Hours
Winter	88	23·86
Spring	92	18·21
Summer	93	15·66
Autumn	89	20·17

(Source: Roy and Clarke 2003:104)

A comparison of each of the seasons' lengths shows that there are variations amounting to a few minutes from year to year because of irregularities in the motion of the apparent Sun relative to the equatorial coordinate frame. For the year covering 1999 to 2000, the lengths of the seasons are given in table 6.2.

$1/12^{th}$ part of a year generally calls a month. Months are also sidereal, solar or tropical, lunar, and luni-solar according as the year is. The period taken by the sun to travel one Rashi (zodiac sign) is called a sidereal month, measuring about 30.438 days on average. The period taken by the sun to travel one sign is called a solar or tropical month, measuring about 30.437 days on average. The period taken by the moon to complete one rotation round the sun is called a lunar month, measuring about 29.531 days on average. It may be noted here that the period taken by the moon to complete one rotation round the zodiac of rashis measuring about 27.322 days may also be called a lunar month of 12 rashis or 27 Nakshatras, but it is not in use. Lunar months adjusted with solar months at intervals of 32 or 33 solar months by interpolating i.e. omitting one lunar month from the calendar occurring as an access. This omitted lunar month is known as 'malamasa' (intercalary month). The half period of a lunar month is called a fortnight taken approximately as 15 days. The lighted half between new moon and full moon is known as 'Shukla Paksha' (dark fortnight). Seven continuous solar days named after seven planets are called a week or 'saptaha'. These days were allotted to seven planets as their rulers, though there is no such term as a week or saptaha.

The period between two successive sunrises is known as a solar day including night. Usually the day is meant as the sunlight period, between sunrise and sunset, distinguished from the night. It is practically the period taken by the earth to complete one axial rotation and known as Nakshatra-dina (sidereal day). The interval between two successive passages of a star across the observer's meridian was then called a sidereal day. We have seen that the first point of Aries (Vernal Equinox) is the reference point chosen on the rotating celestial sphere

to define the sidereal day. The time between successive passages of the vernal equinox across the observer's meridian is one sidereal day (Ibid: 87).

More exactly,

1 mean solar day = 24h 03m 56s5554 of sidereal time

1 sidereal day = 23h 56m 04s0905 of mean solar time. Tables for the conversion of mean solar time to or from sidereal time are printed in several almanacs. Any conversion, however, can be performed using conversion tables (see appendix-7).

The day is also measured on a lunar basis as the period of the moon's lying within each 12 degrees from the sun in course of the lunar month, it is known as Chandra-dina (lunar day). According to the Christian calendar, the civil day commences on true midnight or where standard time is used for zero hour of the clock. According to Islamic calendar, the civil day commences on the sunset. The solar day differs from day to day owing to the obliquity of the sun's path and hence in measured as 60 mean dandas or 24 mean hours as shown by our clocks. The sidereal day consists of 23 hours 56 minutes and 4.091 seconds or 59 dandas 50 palas and 10.227 bipalas. It is truly shorter than the solar day, due to the fact that sidereal is attached to a fixed point in the heaven, having no motion of its own about 1 degree per day in the ecliptic.

$1/4^{th}$ part of the day or nighttime is called Prahara. Half of a Prahara is called Praharardha. $1/55^{th}$ part of the day or nighttime is called Muhurta. Prahara, Praharardha and Muhurta are variable in length according to variation in the length of day and night in different latitudes. $1/60^{th}$ part of sidereal is called a Danda or Ghatika; $1/60^{th}$ part of a Danda is called a pala or Bighatika (where 1 Danda/Ghatika=24 minutes, and 1 Pala=24 seconds).

b) Small units of time

Bipala = 1/60 part of Pala

Anupala = 1/60 part of Bipala

Pratyanupala= 1/60 part of Anupala

Prana =1/6 part of Pala

Truti/Amurta= 1/135000 part of a prana

c) Larger units of time

365 solar days = 1 Dibya Dina (divine day)

360 Dibya Dina = 1 Dibya Barsho (divine year)

12000 divine years= 1 Maha Juga (divine yuga)

1000 divine yugas (or 1 Kalpa) = 1 Brahma Dina

71 divine yugas= 1 Manwantara

14 Manwantara= 1 Brahmadina

360 Brahmadina= 1 Brahmabarsha

100 Brahmabarsha= 1 Brahma Ayu (duration of creation)

The duration of yugas, Mahayugas, and Brahmadina is a controversial matter. However, traditional astronomers pointed out some other categories of time, viz.

Brahma lives 100 years (Brahman years, not human years)

- One *Kalpa* coincides with one Day of Brahma's life.
- One *Kalpa* corresponds to 4,320,000,000 earthly years.

Earthly time is divided into Yuga, or Ages which are:

- Krita (or Satya) Yuga = 4,800 years
- Treta-Yuga = 3,600 years
- Dwapara-Yuga = 2,400 years
- Kali-Yuga = 1,200 years

- For a total of 12,000 years.
- The four Yuga make one Mahayuga
  - The 12,000 years must be multiplied by 360, the days of the human year
  - 12,000 x 360 = 4,320,000 years
- Every Kalpa has 1000 cycles of four Yuga
  - 4,320,000 x 1000 = 4,320,000,000 years

d) Specific period of day and night

Purbahna (period of sunlight) = first 1/3 time of daytime

Madhyahna= second 1/3 time of daytime

Aparahna= last 1/3 time of daytime

Sayahna= the even tide/ evening

Pradosh= first 2 Dandas of night

Nishitha= second 2 Dandas of night

Usha= last 2 Dandas of night

e) Local, standard and sidereal time

Local time is the time elapsed from local sunrise expressed in mean time. As the duration of a solar day varies from day to day. Local time is always reckoned in time as shown by clocks. As the earth rotates on its axis 360 degrees round the sun from west to east in 60 dandas,

local time is advanced in the east by dandas or palas equivalent to 4 minutes per degree of longitude. As, for example, when it is 15 dandas or 6 hours from sunrise at longitude 80-degree east, it is then 16 dandas or 6 hours and 24 minutes at 86 degrees east longitude.

Standard time is the local time of a particular longitude selected by a state for common use. It may be altered if required at any time by the state. The standard time of different periods may be known from official records, astronomical books, almanacs, etc. Local and standard time may be mutually converted into each other by adding or deducting the difference in time between the local and standard longitudes.

Sidereal time is the time elapsed from the culmination of a fixed point in heaven. In Bangladeshi almanacs the duration of ascendants for particular latitude and their expired portions at sunrise and sunset day to day are given in dandas. Mean time may be converted into sidereal time by adding approximately 10 Bipalas per danda or seconds per hour. For instance, 12 mean dandas= 12 dandas + (12×10= 120 Bipalas)

Alternatively, 2 Palas= 12 dandas and 2 palas of sidereal time. Likewise, 12 mean hours= 12 hours+ (12×10=120 seconds)

Alternatively, 2 minutes=12 hours and 2 minutes of sidereal time. (Shastri, R. 1993)

6.2 Determination of Tide and Ebb

> *"In every 6 hours 13 minutes tide and ebb comes by turns. It is required to forecast high and low tides before going to fish, and we have to consider other fishing-related determinations, such as the lunar phase, tidal coefficient, sun and moon rising and setting times, hours of maximum fishing activity, weather conditions in coastal areas."* (FGD to the researcher 18 October 2014) – Momen Mia (64), a fisherman of Chokoria.

The moon and the sun have a gravitational influence on the water body (that means- canal, river, ocean etc.) causing tides and ebbs. Higher tides than normal occur when the sun and moon are aligned or opposed while lower tides than normal occur when the sun and the moon are at 90◦ to the earth, damping each other's gravitational influence. Many coastal peoples of Bangladesh acknowledged the relationship between lunar phases and the ocean tides, including the connection between higher tide and new or full moon.

Cross-cultural Study: Hulley (1996) has pointed out that, according to the Yolngu people of Arnhem Land (in the Northern Territory of Australia), when the tides are high, the water fills the Moon as it rises at dawn and dusk (full and new moon, respectively). As the tides drop,

the moon empties (crescent) until the Moon is high in the sky during dusk or dawn, at which time the tides fall and the Moon runs out of water (first and last quarter). Warner (1937:368) claims that

> "The Murngin [another name for the Yolngu of Arnhem Land] have a more accurate knowledge of the locations, seasonal, and daily variation of the tides. Anyone who has taken a canoe trip with them along the seacoast quickly learns that this knowledge is immense in detail, well organized, and held by all the men."

Warner subsequently describes the important role of the tides, Moon, and Sun in the Yolngu ceremonies and rituals.

6.3 House Construction Plan

Ecosystem and environment influence all aspects of social life, including the housing pattern. Materials used for housing construction- wood, tin, bamboo, straw, jute-stick, mud etc.- are locally available. Most Bangladeshis in rural areas live in huts. The living huts simple in design is built with bamboo and dry grass in most cases. The soil is alluvial river situation, but due to heavy rainfall, it is not suitable for construction of multistory buildings. Leaves for the house construction, namely Hugla pata, Gol pata, and chone are in abundance in the southeast part of the region. Very few people can afford to have brick-built houses. Straw and tin are very common. In the northern districts of Bangladesh, mud is a common material used as straw and bamboo thatches. However, for construction of any kind of homestead, traditional astronomical knowledge is essential. Because their plan for house making is environment-friendly than any other person. Truly mass people accept their advice in this purpose. Usually, traditional astronomer suggests house directions for making new homestead. According to them, it depends on the season in which the habitation is going to be established. They stated that the direction of 'Naag' (astronomically known as a Milky way) is a great factor here. Rural people believe that, property and happiness exist in the lap side of Naag prosperity; vi's-à-vis sorrow and natural calamities stay in other side. Here is a calendar for reckoning the position of the Naag, viz.

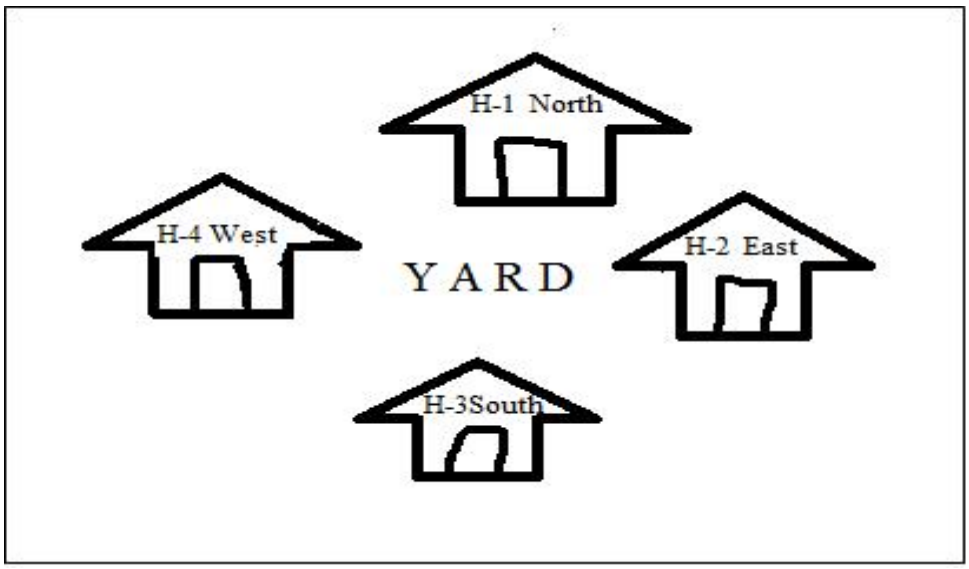
a) From the Bengali month of Falguna to Baishakh (Mid-January to Mid-March) Naag lies in the left, head to the west and tail in the east. In this period, traditional astronomer suggests house should be constructed at the north end.

b) Time between Jaistha to Sravana (Mid-April to Mid-June) Naag lies head in the north and tail in the south; traditional astronomers say, this indicates house should be done on the east end.

c) From Vadra to Kartik (Mid-July to Mid-September) Naag's direction says that the homestead should be made in the south end.

d) Lastly, From Agrahayan to Poush (Mid-October to Mid-December) Naag's direction refers to a West - end house-making.

FIGURE-6.1: Direction of House Construction



Therefore, traditional astronomers believe that one should make four houses year round by turns around a year of yearlong prosperity, safety, and security. It could be depicted in the following manner-

We find the mirror image of this saying among the rural. *Thakur* (traditional astronomer) opined that on Tuesday house construction work is totally unfavorable and very much risky. House damaged by firework if it is not properly obeyed. In a year Sravana (12^{th} Nakshatra) rules earth since 7 Tuesday out of 52 weeks. However, it is not easy to define the certainty and hence *Ghoramy* (the one who built huts professionally) avoid every Tuesday. *Thakur* possesses the notion that if someone follows his or her advice for horse-racing then he has no chance to fall into bad time.

6.4 Weather and Climate

The early Greek astronomers defied climate as the study of the conditions of the atmosphere at a definite time and definite condition. The modern students define it as applied physics of the air and under this head; we study the physical conditions of the atmosphere. The chief elements of the atmosphere which are subject to change and which influence human life on earth are wind, temperature, cloud, humidity, and precipitation. The condition of these elements at any moment is called weather. Because these factors are always changing, the weather is also unstable. However, by observing various conditions of weather at different places and at different hours, an average is drawn. This average condition of elements of atmosphere and weather is drawn after striking a mean of the conditions experienced over a number of years. This average condition of wind, rainfall, humidity, and temperature is known as the climate.

Bangladesh is highly vulnerable to natural disasters, i.e. flood, cyclone, and storm surge, flash flood, drought, tornado, riverbank erosion and landslide are the major concerns here. Abnormal rainfall, earthquake in the Himalayan ranges aggravates magnitude of disaster. Daily activities of people take place in this region with weather uncertainty for almost half of the year; it may be warm, sunny, and calm one day, and cold, overcast and stormy the next. In addition, the effects of climatic change have a great impact. However, traditional astronomers of Bangladesh try to predict on weather and climate, relying on some natural symptoms. Most of these are transmitted orally, to guide the uncertainty in determining whether the next day will bring fair or foul weather; some can be mentioned here:

a) At the time of sun-rising, if the eastern sky looks gloomy and haggard; it is the indication of season changing.

b) When the rising sun looks rayless and like a heated ball; it indicates of the sunny day.

c) In the midday, if sunlight seems abnormally brighter and warmer then it means rainy season arrived.

d) It might be observed that if the sunset was particularly red, the following day often brought fair weather; that means, a red sunset means dry weather the next day. When the setting sun observed a ruddy glow continuously that indicate sunny days are coming.

e) In the sunset, if the northern sky seems scarlet, that means the probability of a rainstorm. In other words, red sky at evening means good weather is coming, on the contrary, red sky in the morning refers bad weather is approaching.

Cross-cultural study: North American variation says-

"Red sky in the morning, sailors take warning.
Red sky at night, sailor's delight."

(As well as other variations, such as from Italy, Denmark/Norway, in some variations, 'sailor' is replaced by 'shepherd')

Scientific explanation: Weather systems typically move from west to east, and red clouds result when the sunshine on their undersides at either sunrise or sunset. At these two times of the day, the sun's light is passing at a very low angle through a great thickness of the atmosphere. The result is the scattering out of most of the shorter wavelengths—the greens, blues, and violets—of the visible range, and so the sunlight is heavy at the red end of the spectrum. If the morning sky is red, it is because clear sky to the east permits the sun to light the undersides of moisture-bearing clouds coming in from the west. Conversely, in order to see red clouds in the evening, sunlight must have a clear path from the west in order to eliminate moisture-bearing clouds moving off to the east.

f) A flash of lightning in the north-eastern direction indicates the heavy thunder shower.

g) In the south sky if Duany (last two stars in the south) exists in same line, then calm weather noticed, a different manner notices rough weather.

h) It is believed that when circle of light rings the moon or sun, rain is approaching on the run. These are indicators that weather conditions are likely to change in the next 18 to 36 hours.

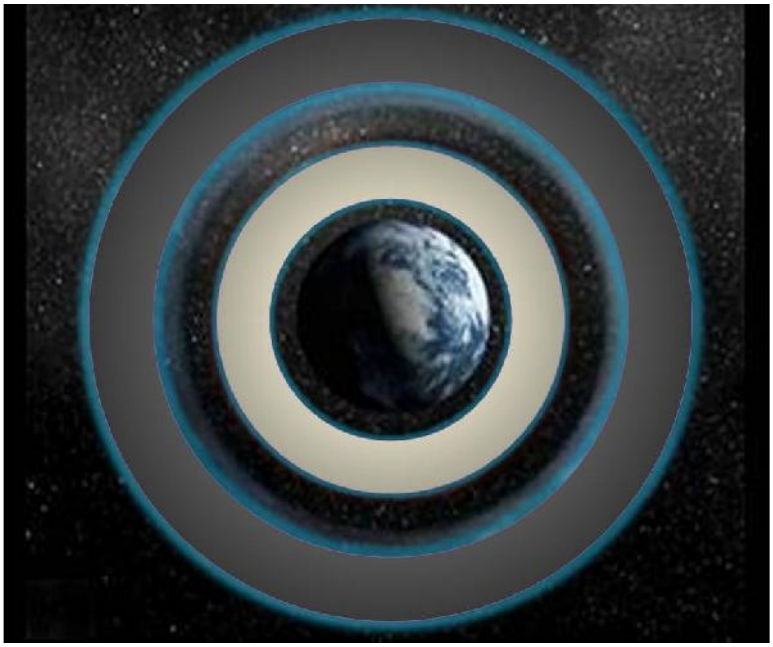
Picture-6.1: Solar and lunar Circle of light is a precursor to rain (Source: Public Domain, Wikipedia)

Scientific explanation: A circle of light (halo) around the sun or moon is caused by the refraction of that body's light by its ice crystals. Such high-level moisture is a precursor to

moisture moving in at increasingly lower levels, and is a good indicator that an active weather system is on its way. Halos naturally grow into what is known as "Sada Akash" (White sky), when the sky appears clear, but the typical blue is either washed-out or barely noticeable. This high, thick white cloud is a clear indicator of an approaching near to the ground. In the coldest days of winter, a halo around the sun is evidence of very cold and typically clear air at and above the surface.

k) When the clear moon seen in the sky, it refers to cold soon.

Scientific explanation: On clear nights, when there is no cover of cloud to absorb the heat stored in the earth throughout the day, the temperature will cool quickly after sunset. If there is no wind even then the temperature will decline shortly.



Picture-6.2: Moon Belt (Source: NASA webpage; illustrated and modified by the researcher)

l) In the Chandrasova (moon belt), if any star stay, then it indicates that there is a high probability of rains. It should also note that when the belt appears thick; rain will fall soon, but drought may arrive when it appears thiner.

m) If stars seen brightly in the sky, it indicates, cold night appears.

Scientific explanation: Moisture in the air tends to dim or redden the light from the sun, moon and stars. Moisture or clouds act as a blanket, in the atmosphere/sky, retaining the heat

stored in the earth during the day. On nights when there is less moisture or cloud, the temperature will cool quicker and stars will appear brighter.

n) There is a probability of being drought, when rainfall in daytime in the early rainy season and cloudless stars twinkled at night.

o) On the night of Jaistha (from May 15 to June 15) if the stars observed densely it symbolizes heavy rainfall in the coming season.

Scientific explanation: As clouds increase in the night sky, stars will appear to be huddled together. As cloud increases, so does the chance of rain. Therefore, the idea that significant celestial events were incorporated into oral tradition is supported by the scientific explanation.

p) The rainbow when observed in the west sky that indicates coming drought, contrariwise east side's rainbow refers to heavy falling.

Picture-6.3: Kodale Megh (Source: Public Domain, Wikipedia)

q) The sky covered with Kodale Megh (ax-spade cloud) denotes rain's arrival.

r) When the sky covered with Tula Megh (cotton-like cloud) indicates a dry day ahead.

s) In the month of Vadra (from August 15 to September 15), if the waist-belt of Orion (Kaal Purush) observed in the midnight, it indicates a rough or stormy weather.

Note: It has not been proven that the Orion has any effect on weather changes. Moreover, it does not assist in weather predictions.

Picture-6.4: Setting Sun (Clicked by the researcher, dated: 06 June 2015 at Tanguar Haor, Sunamganj)

The above-mentioned experiences accumulated over the generations to produce weather forecasting that has been a human desire for a long time to make accurate climate predictions. For the farmer, peasant, sharecropper and Agri-labor wanting to plant crops, for the businessperson about to send a boat, cargo, or ships on the trade, forecasting of tomorrow's circumstances might mean the difference between success and failure. This traditional astronomical knowledge of weather and climate remaining in our society and culture from immemorial time. Contemporary astronomers merely try to explain it and adjoin some new. It is needless to say that our ancestors gained the fore-mentioned knowledge from the experiences of nature. Ray and Cilla Norris (2010) has explored the importance of astronomy in Australian Aboriginal cultures. Griffin-Pierce's study of Navajo Ethnoastronomy (1992) focused almost entirely on the ritual context of astronomical lore and how those could be connected with observations of the sky. Her study provides valuable insights into Navajo culture, but lacking those details that would relate observation, conceptual frameworks, and cultural context.

6.5 Astronomy System and Crop Calendar

Bengali calendar is of great help to the peasant of Bangladesh for the determination of agricultural timeframe. Moreover, traditional astronomers play a effecting role for them. From directory panjika (almanac), they consider the favorable days for cultivation. In this regard, they compiled some rules; farmers, with great care, obey this and make use of its guideline for harvesting work. Remarkable rules mentioned below:

a) Going to the field, at first one should resolve the directions and then start tiling from east-end to the west;

b) One should not cultivate land during the full moon. Who cultivates during this time is certain to suffer for whole life. His oxen suffer from rheumatism and he is always suffering from shortage of food.

c) For each crop, there is a specific timetable for sowing and for harvesting. The following timetable has been prepared because of peasant's practices

TABLE-6.3: Specific Timetable for Sowing and Cutting Major Crops

Serial	Crops	Sowing Period	Cutting Period
1	Aush Paddy	Baishakh to Asharh (May to July)	Vadra
	Banana		After one year
	Sugar cane		Ashwin
	Turmeric		Kartik
2	Aman Paddy	Shrabon to Ashwin	Paush
	Betel-leaf		After 2/3 years
	Brinjal		Agrahayan
3	Boro Paddy	Kartik to Paush (November to January)	Falgun
	Mustard		Chaitra
	Pulse		Chaitra
	Potato		Vadra
	Wheat		Baishakh
	Garlic		Falgun
	Onion		Falgun
4	Paddy	Magh to Chaitra (February to April)	Jaistha
	Jute		Asharh
	Betel-nut		After 4/5 years

d) In the last two decades for magnitude, irrigation and fertilizer employment introduced a pervasive change in the rural agrarian system. Now in semi-urban all fruits and roots, vegetables are available throughout the year. Thereafter, in the remote areas and backward places of Bangladesh, the fore-noticed agricultural timetable are followed extensively.

Crop failure due to drought or excessive rain is believed to be a result of sin committed by people. On the first day of harvesting, a tuft of paddy is brought home and paced above the gateway of the house. After the harvesting season, traditional astronomers and some neighboring guests are invited to eliminate the impact of evil planets and pray for the well being of their family. A grand feast cooked with rice is given. The carpenters who make the cultivates receive their remuneration on this occasion in kind, usually paddy for the whole year.

6.6 Indications of Planets

At the outset of this thesis, it has been mentioned that traditional astronomers are the composition of two distinctive disciplines; one is astronomy, which belongs to the mainstream of science, the other is astrology, which is defined as pseudo-science. Like astronomy, astrology beliefs in nine planets. Among the nine planets, human knew the sun and the moon from the commencement of human life, as apparently largest and most phenomenal bodies in heaven, different from the stars. Rahu and Ketu were conceived as demon's head and tail causing eclipses. Other planets were discovered by from their movement through the fixed stars. Therefore, they were comparatively less attached to any traditional astronomical significance. It was several thousands of years later on that they were taken as symbols for the purpose of astrology along with traditional astronomy. Hindu astronomers use epicycles (like Ptolemy) to describe the motion of the planets in a geocentric solar system. Epicycles are necessary to account for retrograde motion. Traditional astronomers speak of Pravaha (a celestial wind) the force that moves the planets. There is a famous Sanskrit saying when translated means, "In all directions, Sun, Sun, Sun." Seems to be suggesting that all the stars are suns, just further away.

In a vague sense, planets symbolize phenomenal world while rashi symbolizes the physical. Indications of rashis are conceived in similarity to the human body in different forms of evolution while indications of planets are conceived in similarity to the human life in different functions such as behavior, sex, appearance, complexion, age, organic system, temperament, occupation, quality, faculty, familial relations etc. What is true for individual life is shown in collective life, such as family, society, state, elements of energy, species of life, animals, plants, metals, gems, herbs, castes, period of time, places of homestead directions, half-years, seasons, months, fortnights, week, days, periods of day and night, etc.

According to traditional astronomers, various colors create different kind of sensation in the human mind in similarity to which planets indicate different things in nature. In the light of color sensation planets may be conceived as symbolizing all functions of individual life, such as in behavior, Jupiter and Venus liken to the beneficial sun; Mars and Saturn to the malefic; Moon to the benefic or malefic according as it is larger or smaller than half in physical appearance. As regards sex, Sun, Mars and Jupiter are likened to a male; Moon and Venus to a female and Mercury and Saturn to a neuter.

When the planet appears in the sky, any colored rings or rays apparent around it at specific times can point to various auspices, benevolent, and otherwise. White indicates mourning and draught; red the military; green indicates grief and the flood; black illness and death; while yellow means good fortune. Colored rings are comprehended similarly, while some color rays differ- in this case yellow indicates a territory dispute, white cries of misery, green is trouble, and black foretells inundations. Indications of Rahu and Ketu do not conceive that according to any apparent color of their own because they are incorporeal bodies having no apparent color. Their indications are conceived according to the color of their shadow casts on the sun and the moon during eclipses, though some of the indications are difficult to account for. A table for planetary indications in collective life is given below:

TABLE-6.4: Planetary Indications in Collective Life

Planet	Family	Society	State
Aditya- the Sun; Son of Aditi (Unchangeable)	Family head	Leaders, headman, influential persons	Head of state (president & prime minister)
Soma- the Moon (Peace, gentleness)	Housewife, senior female adults etc.	Producer, agriculturists, fisherman etc.	Different ministers; head of food, health, and public welfare
Ankgaraka – Mars (Burning coal)	Junior male adults	Soldiers, policeman, artisan, builders etc.	Heads of defense, military and police
Budha – Mercury (Intellect)	Children	Traders, agents, authors, negotiators, reporters, middleman etc.	Heads of trade and commerce, public relation etc.
Brihaspati – Jupiter	Senior male adults	Theologians, lawyers, advisers etc.	Heads of development, agriculture, industry, production,

(Great protector)			culture, education etc.
Shukra – Venus (Refined, sensual)	Junior female adults	Artists, physicians, financer, etc.	Heads of finance, revenue and banking etc.
Shani – Saturn (Slow)	Strangers, servants, etc.	Laborers, Depressed, neglected person etc.	Heads of labor, employment, panel affaires etc.
Rahu & Ketu	---	Criminals, antisocial, etc.	----

Planetary motions as observed from the earth with the naked eye are generally classified as: 1. Normal (Sama) 2. Fast (Shigra) 3. Slow (Manda) 4. Retrograde 5. Running (Atichari) and fleeing (Mahatichari). In Surya Siddhanta two more kinds are mentioned by subdivisions.

As implied by names, and in the light of symbolism normal motion indicates happening of result in the normal course of time: first motion indicates a rapid course, slow motion indicates a slow course, retrograde motions indicate quick, temporary course and falling motion indicates a drastic permanent course.

6.7 Identifying Different Sets of Stars

For thousands of years human continues to draw an imaginary portrait on the starry sky's body. Some brighter stars are immemorial to them as they have fictive relations with many heroic episodes, romantic stories, goddess or demon's histories, jealous annals, etc. Relevant names have been kept to identify them; actually, it is nothing but an effort of human to make relations with far-off twinkled stars. It's not an easy task to recognize the stars, one should have an apparent idea on astronomy, geography, and if possible astrophysics for this. During conversation and discussion, traditional astronomer was of opinion (sharing the life history with the researcher 29 June 2015) that 'one must have laborious endeavor and sharp aptitude to achieve the goal.' Traditional astronomers of Bangladesh can identify different sets of stars in different seasons. With an objective to study stars, they sometimes use a telescope. Studying stars they predict about weather and climate, determine agriculture, age, and other human events.

Milky Way is the system of stars that contain our sun and planets, seen as a pale band in the sky. In our open eyes, the Milky Way seems like a snake in its physical shape. For this reason, traditional astronomers of our country recognize Milky Way by the Bengali term 'Naag' (snake); aboriginal cultures of Australia share astronomical observations such as

'Emu in the sky' (Norris and Norris 2009); Maori peoples of New Zealand observe 'The Mangaroa (shark) in the sky' (Harris and Matamua et al. 2013); while the Inca of the Peruvian Andes seen 'The Llama (South American camelid) in the Sky' (Hamacher 2011). The above examples reveal to us, we see actually, what we want to see. In other word, we can say that – what we are thinking here on earth, are depicted there in the starry-sky. However, some notable stars in our Milky Way are as follows:

TABLE-6.5: Star List of Traditional Astronomy

Serial	Bengali/Indian Name	Western Name	Constellations	Comment
01	Renuka	Caput Meduci	Perseus	
02	Mayaboti	Algol	Perseus	
03	Kutharpristho	Mirfak	Perseus	
04	Amol	Hamnal	Mesh (Aries)	
05	Sherastran	Sheratan	Mesh (Aries)	Phonological similarity between Bengali & Western name
06	Mukhorosmi	Mesarthim	Mesh (Aries)	
07	Menkaton	Menkar	Timy (Cetus)	Phonological Similarity
04	Maar	Mira	Timy (Cetus)	Phonological Similarity
08	Meen Puschay	Deneb Kaitos	Timy (Cetus)	In Arabic, it means the tail of Cetus; while it refers to tail of fish in ancient India.
09	Urha	Menkalinam	Auriga	Right-chest star of Brahma
10	Brahma Redoy	Capella	Auriga	Left-chest star of Brahma
11	Putna	Crab Nebala	Breesh (Tauras)	
12	Binota	Plecione	Breesh (Tauras)	
13	Uma	Atlas	Breesh (Tauras)	
14	Preeti	Merope	Breesh (Tauras)	
15	Dev Sena	Alcyone	Breesh (Tauras)	
16	Agni	Alnath	Breesh (Tauras)	
17	Lojja	Electre	Breesh (Tauras)	
18	Sonnoti	Caeleno	Breesh (Tauras)	
19	Anusua	Taygete	Breesh (Tauras)	
20	Somvuti	Maya	Breesh (Tauras)	
21	Holdiboron	Aldebaran	Breesh (Tauras)	Phonological Similarity
22	Onil	Wasat	Mithun (Gemini)	
23	Som Taara	Pollux	Mithun (Gemini)	
24	Vishnu Taara	Castor	Mithun (Gemini)	
25	Holbola	Alhena	Mithun (Gemini)	

26	Usha	Alnitak	Kaalpurush (Orion)	
27	Chitralekha	Mintaka	Kaalpurush (Orion)	
28	Bannraza	Rigel	Kaalpurush (Orion)	
29	Ardra	Betelgeux	Kaalpurush (Orion)	It's the 'Jogtara' of Bishakha
30	Kartikeo	Bellatrix	Kaalpurush (Orion)	
31	Aniruddha	Alnilam	Kaalpurush (Orion)	
32	Anok	Heka	Kaalpurush (Orion)	
33	Lubdhok	Sirius	Mrigabadh (Canis Major)	It is also called 'Shwa' means hunter dog
34	Agosta	Canopus	Argonavis	
35	Madhu Chakra	Pracsepe	Korkot (Cancer)	
36	Khor	North Aselus	Korkot (Cancer)	
37	Gordhov	South Aselus	Korkot (Cancer)	
38	Tomor	Al-Hamarin	Korkot (Cancer)	
39	Prattush	Gomeisa	Shunee (Canis Minor)	According to Indian Myth, these two stars are the get keeper of Jom
40	Pravash	Procyon	Shunee (Canis Minor)	
41	Money	Rasalas	Sinha (Leo)	
42	Arjun	Subra	Sinha (Leo)	
43	Purbafalguni	Zosma	Sinha (Leo)	
44	Uttarfalguni	Denebola	Sinha (Leo)	
45	Mogha	Regulus	Sinha (Leo)	
46	Sinha Kokud	Algiba	Sinha (Leo)	
47	Kaleya	Alphard	Hydra	
48	Arundhati	Alcor	Soptorshi (Ursa Major)	
49	Bashitha	Mizar	Soptorshi (Ursa Major)	
50	Angira	Alioth	Soptorshi (Ursa Major)	
51	Morichi	Benetnasch	Soptorshi (Ursa Major)	
52	Otry	Megrez	Soptorshi (Ursa Major)	
53	Pulostya	Phecda	Soptorshi (Ursa Major)	
54	Puloho	Mirak	Soptorshi (Ursa Major)	
55	Krotu	Dhube	Soptorshi (Ursa Major)	
56	Chitra	Spica	Konnya (Virgo)	
57	Srimaata	Syrma	Konnya (Virgo)	Phonological Similarity
58	Zanu	Zewin	Konnya (Virgo)	
59	Zopjopa	Zavijava	Konnya (Virgo)	Phonological Similarity
60	Navitara	Porrima	Konnya (Virgo)	
61	Drakshahorony	Vendimiatrix	Konnya (Virgo)	
62	Anamika	---	Korotol (Corvus)	

63	Konistha	Alchiba	Korotol (Corvus)	
64	Angustha	Algorab	Korotol (Corvus)	
65	Dhruvo	Polaris	Loghu Soptorshi (Ursa Minor)	
66	Plobongo	Kochab	Loghu Soptorshi (Ursa Minor)	
67	Swati	Arcturus	Bootes	
68	Torit	Hakrabi	Tula (Libra)	
69	Bishakha	Zubenel Genubi	Tula (Libra)	
70	Soumyakilok	Zubenel Chameli	Tula (Libra)	
71	Joy	Rigil Kuntaurus	Centaurus	
72	Bijoy	---	Centaurus	
73	Kohinoor	Alpheca	Corona Borealis	
74	Shuk	Shaulah	Brischik (Scorpius)	
75	Anuradha	Dschubba	Brischik (Scorpius)	
76	Bali	Akrab	Brischik (Scorpius)	
77	Jestha	Antares	Brischik (Scorpius)	
78	Saron	Lesath	Brischik (Scorpius)	
79	Kongso	Thuban	Dragon (Draco)	
80	Sarpomony	Etamin	Dragon (Draco)	
81	Nohush	Alwaid	Dragon (Draco)	
82	El-Asich	Ashibis	Dragon (Draco)	Phonological Similarity
83	Shelok	Shelak	Beena (Lyra)	Phonological Similarity
84	Ovijit	Vega	Beena (Lyra)	
85	Shulfolok	Shulaphat	Beena (Lyra)	Phonological Similarity
86	Uttarasharah	Nurki	Dhonu (Sagittarious)	
87	Purbashara	Kaus Australis	Dhonu (Sagittarious)	
88	Puschay	Deneb	Bok (Cygnus)	Arabic Deneb means tail as well
89	Bokmukh	Alberio	Bok (Cygnus)	
90	Shrabana	Attair	Eagle (Aquiolla)	
91	Korno	Tarazed	Eagle (Aquilla)	
92	Basudev	---	Delphinus	
93	Mokor Puscha	Denebalgedi	Capricornus	
94	Shatovisha	---	Kumvo (Aquarious)	
95	Bidur	Sadalchiba	Kumvo (Aquarious)	
96	Gandhary	Sadalsud	Kumvo (Aquarious)	
97	Dhretorastro	Sadalmelik	Kumvo (Aquarious)	
98	Boshistha	---	Cassiopeia	

99	Goutom	Schedar	Cassiopeia
100	Jomodogni	Caph	Cassiopeia
101	Sunity	Almach	Ardromeda
102	Uttor Vadrapad	Alpheratz	Ardromeda
103	Moscho	Mirach	Ardromeda
104	Kaalkojjo	Cor Corroli	Canes Venatici
105	Swadisthan	Alderamin	Shefali (Cepheus)
106	Ognisom	Alfirk	Shefali (Cepheus)
107	Alya	---	Sarpa (Serpens)
108	Unukalhai	Vismo	Sarpa (Serpens)
109	Mokorpuscho	Deneb Algedi	Mokor (Capricorn)

However, beside these there are some notable stars in our Milky Way are as follows: Cassiopia, Shardul (Lupus), Trishanku (Crux), Mrigabadh (Canismajor), Ekshringy (monceruys), Sarpodhary (Ophiucus), Meen (Pisces). The Pleiades are an open star cluster that can be seen in the northern sky during summer. Krupp (1994) says they are a very special object in the sky, which is recognized by nearly every culture as something special. In some older cultures, such as the ancient Greeks, the Berbers of North Africa, and the Lakota Sioux of North America, the Pleiades were seven women, young women, or "daughters". Jabbar (1994) has written an important book of astronomy in Bangla named '*Tara Parichity*' (Introduction to the stars). This book, written by experienced academics in astronomy, explores various aspects related to stars. Classification of stars, star spheres, position of remarkable stars, star identification, relation between stars and rashis, star catalogues etc. were discussed. In the appendices, a rich star inventory is given.

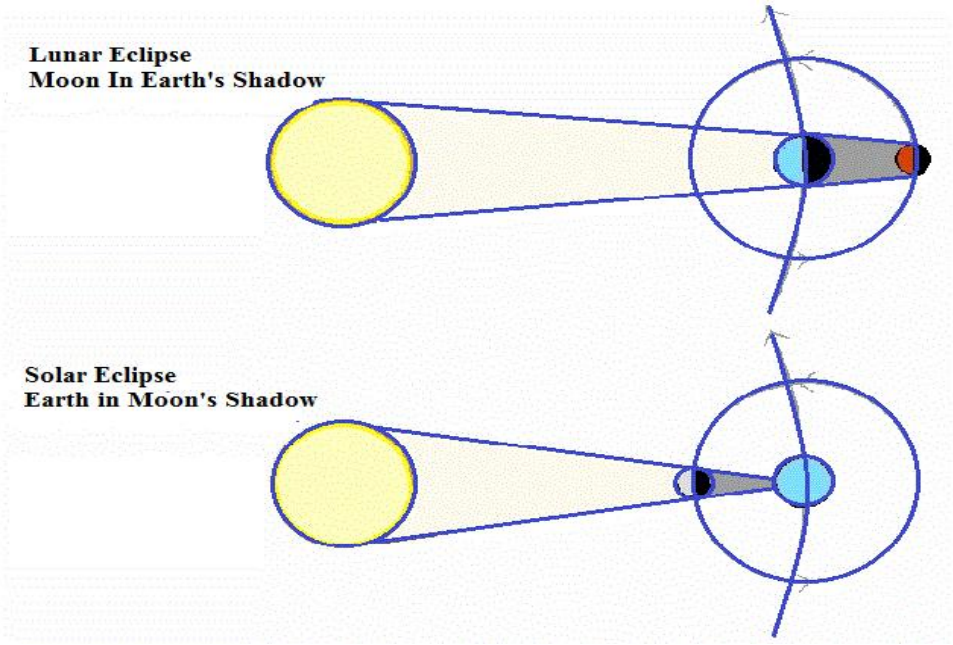
6.8 Lunar and Solar Eclipses, Rahu and Ketu

The respondents state that when the moon's shadow falls on earth or earth's shadow falls on the moon, an eclipse occurs. In the Earth–Moon–Sun rotation system, there are two broad types of eclipses: Suryagrohon (solar eclipses) and Chandrogrohon (lunar eclipses); while Rahu and Ketu[6] were conceived simultaneously as demon's head and tail causing eclipses. Total solar eclipses are rare, and can be seen on average from a given point on the Earth's surface only once every 410 years, while total solar eclipses in the Southern Hemisphere are

[6] In Hindu astrology, Rahu and Ketu are known as two invisible planets. They are enemies of the Sun and the Moon, who at certain times of the year (during conjunction or opposition) swallow the Sun or the Moon causing either a solar or a lunar eclipse.

even more rare, occurring only once every 540 years (Steel 1999:351).

FIGURE- 6.2: Lunar and Solar Eclipses



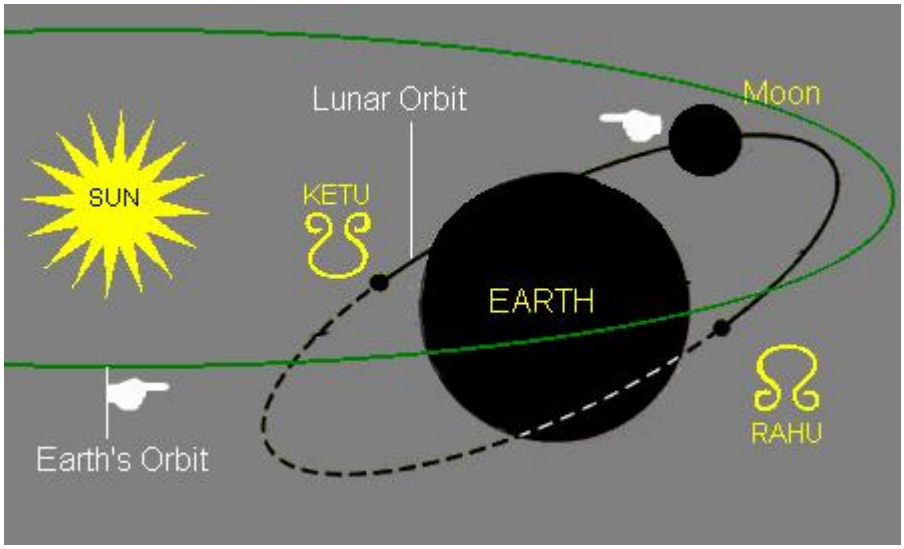
When an object in space comes between the sun and a third object, it casts a shadow on that object, causing an eclipse to take place. During a new moon, the moon lies between earth and the sun. However, most months, the moon travels a little above or below the sun in the sky. A solar eclipse (Suryagrohon) occurs when the moon passes directly between the earth and the sun, blocking sunlight from the earth. The moon's shadow, then hits the earth. Thus, a solar eclipse occurs when a new moon blocks our view of the sun. During most months, the moon moves near earth's shadow, but not quite into it. A lunar eclipse (Chandrogrohon) occurs on a full moon when the earth is directly between the moon and the sun. During a lunar eclipse, earth blocks sunlight from reaching the moon. The moon is then in earth's shadow and looks dim from earth. Lunar eclipses occur only when there is a full moon because the moon is closest to earth's shadow at that time. Many people hold a negative view of solar and lunar eclipses. They could be a warning of a terrible calamity, an omen of death and disease, or a sign that someone was working black magic (Mudrooroo 1994:59).

> "We are to witness an eclipse of the sun next month. Strange! All the natives know about it; how, we can't imagine."— Peggs, A. J. (1903:358).

According to elderly people, solar or lunar eclipses caused reactions of fear and anxiety for many people. They are struck with great fear at first, but relieved when the eclipse passed with no harm having cool to anyone. In the Vedic literature, it is repeatedly mentioned that Rahu causes solar and lunar eclipses by passing in front of the sun or the moon. In later, Rahu

and Ketu are defined as the ascending and descending nodes of the ecliptic and the equator. When the Sun and the Moon come together at these points, we get a solar eclipse at ascending node and lunar eclipse at descending node. Their mathematical equations are set up by the time of Arybhatta (about 500 AD) and eclipses are accurately calculated thereafter. To many people, this seems to blatantly contradict the modern explanation of eclipses that holds that a solar eclipse is caused by the passage of the moon in front of the sun and a lunar eclipse is caused by the moon's passage through the earth's shadow. However, the actual situation is somewhat more complicated than this simple analysis assumes. The reason for this is that the Surya-Siddhanta presents an explanation of eclipses that agrees with the modern explanation, but also brings Rahu (See the figure- 6.3). This work explicitly assumes that eclipses are caused by the passage of the moon in front of the sun or into the earth's shadow. It describes calculations based on this model that make it possible to predict the occurrence of both lunar and solar eclipses and compute the degree to which the disc of the sun or moon will be obscured. At the same time, rules are also given for calculating the position of Rahu and other, similar planet named Ketu. It turns out that either Rahu or Ketu will always be lined up in the direction of any solar or lunar eclipse.

FIGURE-6.3: Rahu and Ketu



(As quoted from Richard L. Thompson - Sadaputa dasa - 1989. "Vedic Cosmography & Astronomy)

The positions assigned to Rahu and Ketu correspond to the ascending and descending nodes of the moon - the points where the orbit of the moon (projected onto the celestial sphere) intersects the ecliptic, or the orbit of the sun. These nodal points rotate around the ecliptic from east to west, with a period of about 18.6 years. One of them must always point in the direction of an eclipse, since the moon can pass in front of the sun or in the earth's shadow only if the sun, moon and the earth lie in a straight line. Thus, by placing Rahu and Ketu at the nodal points of the moon, the Surya-Siddhanta conforms both to the modern theory of eclipses and with the Vedic explanation involving Rahu and Ketu.
One objection that may be raised to the explanation given in the Surya-Siddhanta seems to be a cheap compromise between the Vedic account of eclipses (which many will regard as myths) and the modern account (which many will regard as an import into India from the Greeks). It is true that Rahu and Ketu seem to play a rather extra role in the eclipse calculations given in the Surya-Siddhanta. However, there are reasons for supposing that these planets do not appear in these calculations as a mere decoration.

Rahu and Ketu plays an important role in Hindu astrology. This is because astrologers need some system of calculation that will tell them where Rahu and Ketu are at any given time. We have argued that astrology has traditionally played an important role in Vedic culture. From this, it follows that some methods for calculating the positions of Rahu and Ketu have traditionally been required in Vedic society. Since we have no evidence that any other method of calculating these positions has ever been used, this can be taken as an indirect indication that the method used in the Surya-Siddhanta has coexisted with the Vedic Shastras for a very long time.

Of course, by this argument we cannot conclude definitively that this particular method of calculation has always been used. Nevertheless, we can at least be sure that the Vedic society, with its emphasis on astrology and the astronomical timings of religious ceremonies, has always needed more than a mere qualitative story to account for eclipses and other astronomical phenomena.

Chapter Seven
Predictions and Prescriptions

The use of sky knowledge in prediction of resources, and in cultural understanding of the law, has long been acknowledged, but we also describe the use of traditional astronomy in a scientific manner. In accordance to traditional astronomy, science is an intellectual endeavor to describe the natural world within an appropriate cultural context, resulting in predictive power and practical applications such as navigation or timekeeping. For example, the coastal people of Bangladesh have explained the tides as the Moon filling and emptying as it passed through the ocean at the horizon, which is a perfect explanation provided by the available scientific evidence. This evidence-based approach to understanding the world in an appropriate cultural context correctly predicted how the height of the tide varies with the phase of the moon, with the highest tide occurring at the Purnima (full moon) and Amabasya (new moon). From the time immemorial, the people of Bangladesh have been facing recurrent attacks of storms, cyclones and floods which have forced them to develop an inherent habit to look at the sky regularly to observe the movements of the clouds and to calculate when a storm, cyclone or flood would come and when to arrange safe refuse from its attacks.

Traditional astronomers are essential part of society at the grass roots of far reaching villages. They are the first who come in contact with local people with helping mood in different natural calamities. They give necessary tips to the victims in calamitous moment and from the very beginning forecast cautionary signals on coming difficulties for the dwellers. Not only this, they were also of good help for preventing various diseases with natural herbs. However, this chapter focuses on different predictions which concerns about health and diseases, agriculture and cattle rearing, favorable and unfavorable moment, marriage matching, horoscope making, etc. For each concerning issue suggested prescriptions of traditional astronomers are also discussed.

7.1 Zodiac and Star System

In both astrology and Traditional astronomy, the rashi (zodiac) is a circle of twelve 30° divisions of celestial longitude that are centered upon the ecliptic, the apparent path of the sun

across the celestial sphere over the course of the year. Modern astronomers state that rashis has no astronomical significance; it is nothing but mental construction. However, for the traditional astronomers zodiacs are important to measure a man, male or female. In an ordinary law, rashis symbolize the physical world just as planets symbolize the phenomenal. Traditional astronomers opined that rashis are similar to the objects and animals within the range of human senses. This similarity is conceived in two forms, 1) according to the order of evolution and 2) according to appearance. The first one is scientific, but the latter one seems to be an invention of later traditional astronomers.

The rashi indicates the destiny of an individual. In single form, the zodiac as a whole is as similar to the human body as a whole and rashi is similar to a part of the body in gradual order from Mesh (Aries), which indicates head; Breesh (Tauras) refers to face; Mithun (Gemini) to neck and arm, Korkot (Cancer) to breast, Sinha (Leo) to belly; Konnya (Virgo) to abdomen and waist; Tula (Libra) to genitals; Brischik (Scorpius) to anus; Dhonu (Sagittarious) to thighs; Mokor (Capricorn) to knees, heaps and back; Kumvo (Aquarious) to legs; and Meen (Pisces) to feet.

In three-form evolution each three rashis in serial order from Mesh is conceived as similar to three-forms of Chara (mobile), Sthira (fixed), and Dishwavaba (dual) in energy. May be similarly conceived as bilious, nervous, and mucous in metabolism; faint, deep, and medium in stature; slim, fat, and medium in bulk; long, broad and thick in dimension; vertical, flat, and oblique in angle; torrid, frigid, and temperate in climate; animal, vegetable, and mineral in species and so on.

In four-form evolution each rashi in serial order from Mesh is conceived as similar to four-forms of Agni (fiery), Prithwi (earthly), Bayu (airy), and Ap (watery) in elements; Khatriya (ruler), producer, and Baishya (trader), Sudra (laborer) and Brahmins (theologian) in the social structure; East, South, West and North in direction and may be similarly conceived as front, right, left, and back in position and so on.

It may be noted that rashis are not conceived with more than four forms in view of the fact that the maximum number 12 dividable into further integral parts except 6 that have no practical usefulness. However, rashi indication according to appearance can be noted by following table-

TABLE-7.1 : Rule for ascertaining the asterisms (constellation)

Name of Zodiac (Indications according to appearance)	Number of Nakshatra	Degree of part	Minute or Kala
Mesh (Aries) is conceived as appearing like a ram of highlands, indicating animals that are red, large, quadruped, living in highlands, rising by back, strong at night and valorous in nature.	1	13	Upto 20
	2	26	Upto 40
	3	30	Upto 0
Breesh (Tauras) is conceived as appearing like a bull indicating animals that are white, tall, quadruped, living in plains rising by back, strong at night and valorous in nature.	3	10	Upto 0
	4	23	Upto 20
	5	30	Upto 0
Mithun (Gemini) is conceived as appearing like human-pair of male and female with a club and ahorp, indicating animals which are green, medium sized, biped, living in the plains, rising by head, strong at night and sober in nature.	5	6	Upto 40
	6	20	Upto 0
	7	30	Upto 0
Korkot (Cancer) is conceived as appearing like a crab, indicating animals, which are pink, fat, multi-legged, living in the woods, rising by back, strong at night and sober in nature.	7	3	Upto 20
	8	16	Upto 40
	9	30	Upto 0
Sinha (Leo) is imagined as appearing like a lion, indicating animals, which are yellowish white, large, quadrupedal, living in the woods, rising by head, strong at day and sober in nature.	10	13	Upto 20
	11	26	Upto 40
	12	30	Upto 0
Konnya (Virgo) appears like a virgin of woods, indicating animals, which are black, medium sized, biped, living in the woods, rising by head, staring at day and wild in nature.	12	10	Upto 0
	13	23	Upto 20
	14	30	Upto 0
Tula (Libra) is imagined as appearing like a weighing balance, indicating animals, which are black, medium sized, biped, living in the plains, rising by head, staring at day and valorous in nature.	14	6	Upto 40
	15	20	Upto 0
	16	30	Upto 0
Brischik (Scorpius) appears like a scorpion, indicating animals, which are yellowish blue (Pischanga), small, multi-legged, living in cavities, rising by head, strong at day and wild in nature.	16	3	Upto 20
	17	16	Upto 40
	18	30	Upto 0
Dhonu (Sagittarious) is conceived as appearing like a bow held by a biped on the back of a quadruped, indicating animals, which are yellowish blue (Pingala),	19	13	Upto 20
	20	26	Upto 40
	21	30	Upto 0

medium sized, biped in first half and quadruped in the second half, living in the plains, rising by back, strong at night and sober in nature.			
Mokor (Capricorn) is conceived as appearing like a whale with quadruped on the back, indicating animals, which are multicolored (Karbura), large, quadruped in first half living in the woods in the first half and in waters in the second half, rising by back, strong at night and wild in nature.	21 22 23	10 23 30	Upto 0 Upto 20 Upto 0
Kumvo (Aquarious) is conceived as appearing like a pitcher, held by a biped in the water, indicating animals, which are yellowish blue (Bavru), biped, living in the waters, rising by head, staring at day and wild in nature.	23 24 25	26 0 30	Upto 40 Upto 0 Upto 0
Meen (Pisces) is conceived as appearing like a pair of fishes, the tail of one being attached to the head of the other, indicating animals, which are colorless, medium sized, un-legged, living in waters, rising by head and back, strong at day and sober in nature.	25 26 27	3 16 30	Upto 20 Upto 40 Upto 0

However, questions may arise if the similarity in appearance can be regarded as a rational basis for symbolical indication. Of course, the similarity in appearance between artificial objects and animals cannot be regarded as symbolical. The zodiac is similar in appearance with natural objects and animals, so their appearance is regarded as suitable for symbolical indications.

7.2 Health and Diseases

The majority of the villagers in Bangladesh are not health conscious, therefore various diseases appeared and early death that increased at a high rate. People of remote for simple or primary disease come to consult Thakur. Generally, he gives prescriptions for herbal and sometimes homeopathy treatment; stone therapy or color therapy has been given as well. Herbal and homeopathy treatment is usually suggested for-

a) Ear, throat, and nose diseases;
b) Dental diseases;
c) Eye ailments;
d) Heart and breath problems;
e) Lung diseases;

f) Diseases from fever;
g) Sexual problems
h) Skin Problems
i) Ailment in stomach, etc.

In case of complex diseases, they are cent-percent helpless and taking help of supernatural power. There are available instances that have been cured by the treatment of traditional astronomers. Herbal treatment is familiar with the village—its raw material has been collected from local creepers and herbs. It has no side effect therefore is safe for patients. For villagers, it's a major survival strategy against diseases and ailments. Traditional astronomers suggest-

a) Cheerta (Swertia), Neem (Azadirachta Indica), Chandan (Sandal), Halud (Turmeric) for any kind of skin diseases.
b) Thankuni (Indian Penny-wort), Ishobgul (Ispaghula), Gaab (velvet apple), Bot (Banyan), Bel (Wood-apple), Arjun tree to cure dysentery.
c) Amloky (Aamla), Akhandfool (Crown flower), Kontikari, Neem for dental diseases.
d) Arjun, Shimul (Silk cotton), Bot, Tulshi, Rerhi, Ghreetokumary (Aloe vera) for sexual diseases.
e) Tulsi (holy basil), Amloky, Chandon, Cheerta, Nishinda (Vitex negundo), Josthimodhu etc. used for diseases from fever.

Beside these, the folk doctors or the traditional astronomers prescripts different herbal medicines for different diseases.

Gem therapy or study of stones is the oldest pseudo-science known to humankind. For the traditional astronomers gem therapy itself is a complete subject and its study is deep and mysterious. According to the Thakur gems should be prescribed on the basis of complete calculation of horoscope wherein name, date of birth, time and place of birth is required. These gems are suggested for a particular cause like marriage, love, litigation, health, studies, fears, property, speculation, foreign travel, political elevation, and general prosperity etc. these gems/stones are known as lucky stones, which bring good luck and fortune for a particular cause, mentioned above. For example, if someone comes under the zodiac sign of Leo. According to the enumeration of traditional astronomer persons born between Asharh 8 (July 23) to Shrabon 8 (August 23) come under the vibration of planet sun. Sun is a ruler of the assumed man's house; and evidently it stands for his/her protection. Any stone/gem related to planet sun will be known as protected stone for overall prosperity. These gems do

not give any malefic effect. In case of assumed men, lucky stones are as under.

Ruby- weight 4.25 to 14.25 rotti

Amber- weight 4.25 to 6.25 rotti

There are seven days in a week, and each day has 24 hours. A particular planet influences each hour of the day. So any of the above stones must be prepared on Sunday (the day of sun) under the planetary hour of sun. The gem must be fixed in silver with 25% gold of the total weight. The gem should be worn on the ring-finger on any Sunday before 8 am.

In this way, traditional astronomers suggest to worn ring- moti, chuni, neela, gomed, probal, heera, panna etc. for overall prosperity. People of different rashis use this lucky stones to omit malefic effect.

Traditional astronomers who live in semi-urban or urban area take a great help by following color-healing methods. The simplest methods to treat illness with color therapy are with the use of an electric color lamp or with colored glasses, or by color breathing.

a) *Color Ray Treatment:* There are two types of ray treatments-- general diffusion and local concentration. In general diffusion, the light rays are focused on the body, especially the back, the region of the spire and the nervous system. General diffusion is extremely good for recharging tired, nerve cells. The patient should lie down in a relaxed mood, or sit in a comfortable position. Preferably, one should remove clothes and let the light fall directly on the skin. Color treatment by the lamp is advised for only about thirty minutes and not more than one in a day.

   In local concentration, the light is focused on the affected area only. Hence it is advisable to seek guidance of an expert healer to know the nature of the light or color; its quality, intensity, and the time duration before starting with color healing.

b) *Treatment with Color Glass:* One should collect seven glass bottles; each is one of the seven main colors. The colors should be ‘try’ and shades of the colors. Then should fill the bottle with water and place it on the windowsill to absorb the light rays through its colors. One should use distilled water for better results. It is not necessary to have the sunlight falling directly on; the bottle will absorb the light, even if it is a cloudy day. For better result, the bottle of water can be placed in the sun when it rises, and removed after about two hours. Alternatively, let the sunsets in the west. Traditional astronomers suggest drinking this color charged water three times a day.

c) *Color Breathing:* Fresh air contains much more radiation from the sun, stars, planets, and the earth. According to traditional astronomer (interview in the researcher 25

October 2014), 'deep breathing' helps the individual to absorb these rays. The instruction they suggest for color breathing noted here minutely-

> Sit comfortably in a chair in front of an open window. Close your eyes And mentally concentrate on the desired color for three minutes then bend forward and exhale all the air from your lungs and stomach. Allow the body to feel so relaxed that each muscle feels limp. Next, inhale a single deep breath which begins with the expansion of the abdomen and continues up to the ribs and the chest. As you breathe in, count up to eight, then hold the breath for another eight seconds, and finally exhale, taking eight more seconds to do so.

The above exercise is best done immediately before or after breakfast and dinner. However, this breathing practice is just forbidden before sleeping at night. Each of the seven rays may be breathed in according to your need. The red, orange and yellow rays should be visualized as flowing up from the earth to the solar plexus. The blue, indigo, and violet rays should be visualized as being drawn in from the aura. The green rays, which is the midpoint or the center of the spectrum should be seen as flowing in horizontally.

Each of the seven colors has its own healing properties

I. Red is heating. It warms the arterial blood, thus promotes circulation. Red governs the vitality of the physical body, particularly the creative, procreative and restorative processes.

II. Orange has a freeing action upon bodily and mental functions, thus relieving repression of all kinds. It combines physical energy with mental wisdom. It sublimates basic instincts and helps to establish self-control. Orange is warm, cheering, constringent.

III. Yellow rays caring, positive magnetic currents are flexible and have a positive, tonic effect on the nerves. Yellow is a primary color which awakens, inspires and stimulates the intellect.

IV. Green is the color of balanced strength; the color of progress in mind and body. Green is the balancing influence, the symbol of harmony. It does not excite, inflame or irritate it soothes the nervous system.

V. The primary colors, blue has a cooling effect. It lifts, exalts and inspires one towards greater highs of endeavor and achievement. Blue light transmitted

through the correct glass compounds, stops bleeding of the lungs, decreases fevers, cures a sore throat, and has many seemingly understandable functions, if properly applied.

VI. Indigo color is a great purifier of the physical blood stream. It helps to free and purify the mind by controlling the psychic currents in our subconscious minds.

VII. Violet is the highest and most subtle specialization of light. The extreme of violet-purple rays are very stimulating to the nervous system and signifies high spiritual attainment. It provides nourishment for those cells in our upper brain and expand our divine understanding. Violet is the ideal purifier of ideals. It has a great inspirational effect on those associated with music, poetry, painting or any fine art.

The open space in the villages is undoubtedly a blessing which possibly accounts for the absence of such diseases, which are commonly found in congested urban areas. For malnutrition and lack of hygienic sense, diseases like cholera, smallpox, malaria, diarrhea etc. are rampant. Not a single trained practitioner is available in any of the villages under study in urban areas. However, the villagers either rely on indigenous healer, locally known as Kabiraj and Hakim, or seek help from traditional astronomer.

7.3 Agriculture and Livestock

Agriculture in Bangladesh villages is not mechanized rather still follows the age-old pattern. Even at present old-fashioned ploughs are used by cultivators mostly. Our farmers mainly rely on nature, animal and human labor. In this context, the value of traditional astronomical knowledge is great indeed. The peasantry and traditional astronomers, both professions have intimacy for reciprocal relations. All peasants, however, have two things in common, namely dependence on agriculture and simplicity of life. For thousands of years they serve the cultivators in many ways. One example can be drawn here-

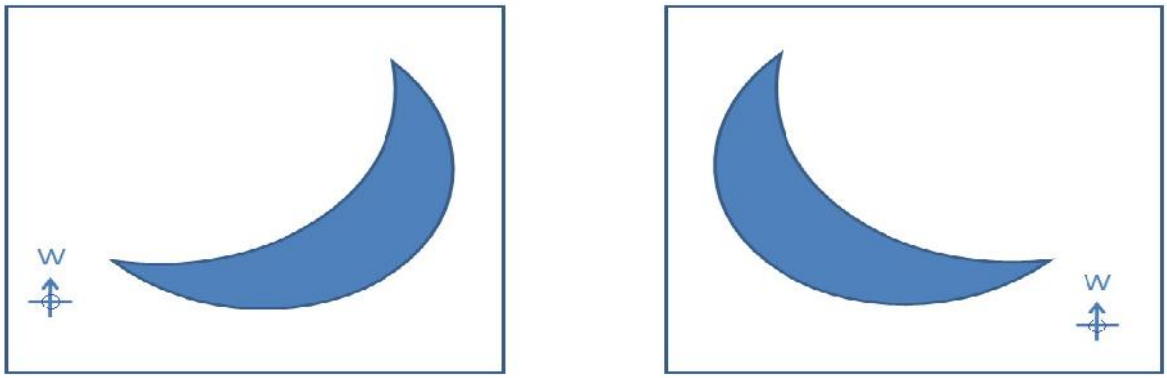
‘The traditional astronomers often predict crop out-turn by studying lunar direction. If the moon’s north seems high and south side slop (see figure-7.1), it is the indication of bumper crop production and cheap market price.

Vi's-à-vi's, when the moon lies north direction, i.e. sloppy north and south side high, this symbolizes high market price and low crop outturn. The old astronomical knowledge related

to agriculture has been placed in Khanar bachon; few of them can be noted here-

[Pronunciation: Nikot sova boshle tara/ brishty hobe musholdhara.
Meaning: When star sets near belt of moon, it indicates heavy shower soon.]

FIGURE-7.1: Two Types of Lunar Directions



[Pronunciation: Jodi Joishthote tara fute, tobe janbe borsha bote.
Meaning: If stars twinkle during Joishtho, it indicates heavy rainfall coming]

Cross-cultural Study: In some cases, the appearance of a star or comet coincided with a natural disaster or disastrous event. For example, the appearance of bright comets in Australian skies coincided with droughts (Parker 1905:99), disease epidemics (Spencer and Gillen 1968:549), war (Morrill 2006:61) or natural disasters (Mowaljarlai and Malnic 1993:194), prompting Aboriginal people to view the phenomenon with fear and apprehension (which is consistent with many cultures around the world). These views were carried through successive generations via oral traditions. Even solar eclipses, which are rare occurrences from any given place on earth, have been incorporated into oral traditions (for details see Chapter 6).

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[Pronunciation: Sravoner pura Vadrer baro, haal chosho joto paro!
Meaning: Whole Shrabon and twelve days of Vadro; cultivate the land, as much as you can!]

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[Pronunciation: Purnima-omay je dhore haal/ taar dhukkho chirokaal!
taar boloder hoy baat/ghore taar thake na Bhat.
Meaning: One who cultivates in full or new moon, he suffers forever! His cow will be sick; there would be no rice to eat at home.]

আঁধারে পড়ে চাঁদের কলা,
কতক কালা, কতক ধলা,
উত্তর উঁচু, দক্ষিণ কাত
ধারায় ধারায় ধানের হাত,
ধান-চাল দুই-ই সস্ড়
মিষ্টি হবে লোকের কথা।

[Pronunciation: Adhare pore chader kola, kotok kala kotok dhola; uttor uchu dokshin kaat, dharay dharay dhaner haat; dhan-chal dui-e sosta, misty hobe loker kotha.
Meaning: Moon phases at night/ partially black and white; high north sloppy south/ plenty of paddy production; paddy-rice both are cheap/ everybody will speak sweetly.]

There is innumerable 'khonar bachon' (Saying by Khona) in the rural people's heart. In rural cultivation system, the value of cattle is great indeed; local people depend on the availability of healthy bullocks, for ploughing; while the cows are domesticated for milk. Poultry is also raised by almost every home with great care, cattle used for ploughing are overall, better looked after. The solvent peasants always have a sufficient number of cattle to meet their own requirements. However, the poor peasants find great difficulty in tilling their fields in time with the limited number of their cattle heads. They have depended on hiring the cattle for ploughing. The cultivators who depend on hired cattle or who practice co-operative lending and borrowing of cattle cannot take the best advantage of the first rains and this enforces them to wait resulting in untimely sowing and poor crops. The absence of milking cows adversely affects the nutritional status of the poor villagers. There is a prediction of traditional astronomer that, if the domestic cows bring forth in the month of Vadra—it is quite unfavorable and except the calf, none should drink the milk.

Cross-cultural Study: The appearance of particular stars at a certain time of the year acted as planting and harvest indicators. For example, the Sun, Moon and stars were an integral

part to the growth cycle of plants and humans, with the Moon and stars in the Maori Society of New Zealand. In general, the Sun was the Mauri (essence) that provided energy for growth in the realm of daylight (te ao mārama) and the Moon was the Mauri which provided energy, warmth and nurturing for growth in darkness. However, the Moon and stars were the key factors during planting and incubation (Smith 2011:8).

7.4 Marriage Matching

Marriage is an essential event of life and a very sacred one for a villager. According to the traditional astronomers, every guardian should test marriage matching of his or her adult child. They demanded as every of them are not conscious about the matter and that's why early death, divorce or separation, continuous dissension etc. prevailed on family life. Will and woe was justified by the rashi is of the bride and groom before marriage, this is called marriage matching.

There are eight kinds of matching, those are i) Varnakut, ii) Vaishyakut, iii) Tarakut, iv) Zonikut, v) Grahmaitrikut vi) Ganamaitrikut, vii) Rashikut, and viii) Trinerhikut. If more than a half - percent proved lucky among the fore-mentioned eight events, then for refines marriage relation will be lawful.

i) Varnakut Ascertainment: Brahmin Varna's Pisces, Cancer, Scorpio; Khatriya's Taurus, and Sagittarious; Vaishya's Aries, Virgo, Capricorn; Sudra's Gemini, , and Aquarius. In another view, Brahmin Varna's Pisces, Cancer, Scorpio; Khatriya's Leo,
Libra, Sagittarious; Vaishya's Taurus, Gemini, Aquarius; Sudra's Capricorn
Aries, and Virgo.

If marriage functioned as hypergamy, that means affinal relations between upper caste's bride and lower caste's groom—one must face early death of the spouses. If one's Nakshatra perforates with his or her counterpart, any of them should try to avoid as the matching is unfavorable.

ii) Vaishyakut Ascertainment: Except Leo the rest rashi's (i.e. Gemini, Libra, Aquarius, Virgo, and Sagittarius) first half are the second part's Vaishya (controllable). The caste part of the rashis except Cancer, Scorpio, Pisces, and Capricorn are Leo's controllable. Other Rashi's Vaishya ascertained by popular practices, for example, Taurus under Aries; Capricorn under Cancer. In this way, if bride's rashi goes under groom's Vaishya rashi then excellent mutual love developed, acting otherwise it may quarrelsome.

iii) Tarakut Ascertainment: Counting numbers from groom's Nakshatra to bride's and vis-à-

vi's from bride's Nakshatra to groom's. The total number should be divided by 9, if the remainder come 3, 5, 7; it is the indication of evil. If the remainder come 1, 2, 4, 8, or 0; then it indicates goodness.

iv) Zonikut Ascertainment: Zonikut of a person determined by his or her rashi Nakshatra. The following table shows different Nakshatra's zoni-

TABLE- 7.2: Different Nakshatra's Zoni

Nakshatras	Zoni
Shatavisha and Ashwini	Stallion
Swati and Hasta	Buffalo
Purbavadrapad and Dhanistha	Lion
Varani and Rebati	Elephant
Krittika and Pushya	Ram
Purbashara and Shrabon	Monkey
Rohini and Mrigashira	Snake
Jestha and Anuradha	Deer
Arudra and Mula	Dog
Uttarfalguni and UttarVadropod	Cow
Chitra and Bishakha	Tiger
Ashlesha and Punerbashu	Cat
Magha and Purbafalguni	Rat
Avijit and Uttarasharra	Mongoose

There is some malicious couple, like: cow and tiger, elephant and lion, stallion and buffalo, dog and deer, mongoose and snake, monkey and ram, cat and rat- one should try to avoid these, similar zoni, is the best matching for newly married couple, separate zoni is good.

v) Grahamaitrikut Ascertainment: Ruling planet's alliance between bride's and groom's rashis is like the equilibrium indicates medical. Ruling planet's hostility refers to bad luck. Here is a table identifying planet's ally, homogenous and enemy.

TABLE- 7.3: Planet's ally, homogenous and enemy

☼ ☼ ☼	**Moon**	**Mars**	**Mercury**	**Jupiter**	**Venus**	**Saturn**	**Rahu**	**Ketu**	**Sun**
Friendly	Sun Mercury	Sun Moon Jupiter	Sun Venus	Sun Moon Mars	Mercury Saturn	Mercury	Venus Saturn	Sun Moon Mars	Moon Mars Jupiter
Neutral	Mars Jupiter Saturn Venus	Venus Saturn	Mars Jupiter Saturn	Saturn	Mars Jupiter	Jupiter	Mercury Jupiter	Mercury Jupiter	Mercury
Hostile	☼ ☼ ☼	Mercury	Moon	Venus Mercury	Sun Moon	Sun Moon	Sun Moon Mars	Venus Saturn	Venus Saturn

vi) Ganakut Ascertainment: One who is born in- Hasta, Swati, Mrigashira, Ashwini, Srabon, Pushya, Rebate, Anuradha, and Punarbashu nakshatras- belong to the devagana.
Born in- Arudra, Rohini, Uttarfalguni, Uttarashara, Uttarvadropad, Varini, Purbafalguni, Purbashara, and Purbavadropad nakshatras- belong to the Naroana. And if someone borns in Jestha, Ashlesha, Bishakha, Mula, Shatavisha, Dhanistha, Krittika, Chitra, and Magha nakshatras- belong to the rakkhasgana. Marriage is best in homogenous context; marriage between devagana and narogana is medial. Familial dissension last long when marriage between devagana and rakkhasgana functioned; early death hit the family life when marriage functioned between narogana and rakkhasgana.

vii) Rashikut Ascertainment: When the bride and groom belongs to the same Rashi owner or each other possesses similarity (i.e. Aries and Scorpio, Cancer and Capricorn, Virgo and Pisces and 4^{th}, 10^{th} or 3^{rd}, 11^{th} are marked as Rajzotak (best matching). Marriage is lucky for above mentioned cases. Many sages and ascetic were of opinion that Rajzotak is far from evil planet's influence, nakshatra pollution, gana, and varna's bad impact.

vii) Trinarhikut Ascertainment: There are three kinds of Narhi- prenarhi, medialnarhi, and postnarhi. The first one consists of Ashwini, Arudra, Punarbashu, Uttarfalguni, Hasta, Jestha, Mula, Shatavisha, and purbavadrapad. Medialnarhi includes Varani, Mrigashira, Pushya,

Purbafalguni, Chitra, Anuradha, Purbasharra, Dhanistha, and Uttarvadrapad. In postnarhi- Krittika, rohini, Ashlesha, Magha, Swati, Bishakha, Uttarashara, Shrabon, and Rebeti exist. In bride and groom's nakshatras belong to one narhi; then narhi perforates cause pollution.

7.5 Favorable and Unfavorable Timings

Traditional astronomers stated that, 'since every action has its reaction; the work of good and bad time is inescapable and unavoidable'. Measurement of the favorable and unfavorable moment is one of the major works of traditional astronomers. Clients are intended mainly to know his or her destiny. To fix any happy occasion or festival people are conscious about good and bad time and strictly obey the matter. The inevitability of the matter is testified by daily occurrences in the individual and national life as well as by numerous historical facts embracing binary oppositions like rich and poor, strong and weak, learned and illiterate, powerful and powerless, clever and foolish, virtuous and vicious etc.

Myths, legends and epics of the countries are nothing but reflections of human experiences; speak of numerous instances of how favorable moment prevails against all oppositions or odd circumstances. This is because question of good time and bad time occupies an important place in the mass mind. Regarding respect to public opinion traditional astronomer reckons favorable and unfavorable moment not for a mere consultation fee, rather with a helping mood from social bindings.

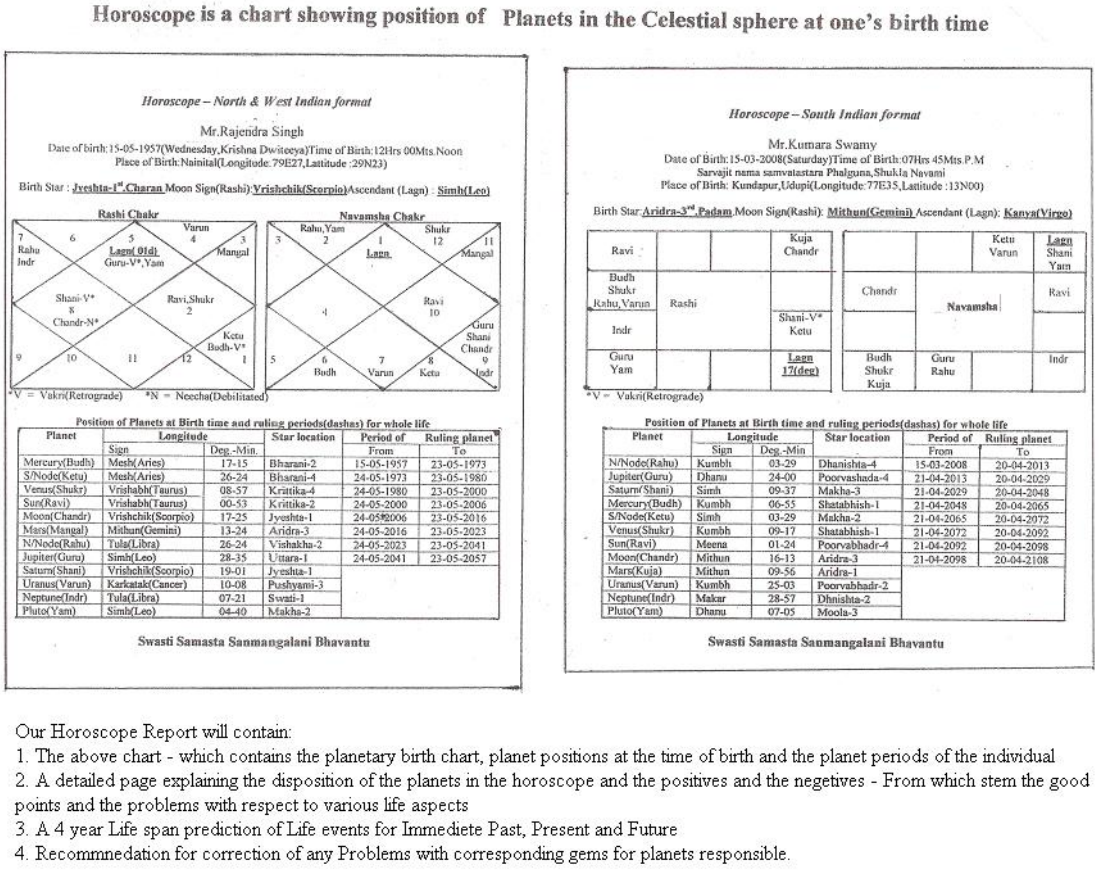
7.6 Preparing Horoscope

A horoscope is a predictive tool for seeing past, present and future. It is a chart or diagram representing the positions of the sun, moon, planets, the astrological aspects, and sensitive angles at the time of an event, such as the moment of a person's birth. The word 'horoscope' has some synonym in Bengali Janampatri, Kundli, Kusthi (brief) and Thikuji (detail); in English include natal chart, astrological chart, which rely on celestial map, sky-map, star-chart, cosmogram, vitasphere, radical chart, radix, chart wheel, and some calculations.

Horoscope may be brief, medium, or elaborate. It is the statement of somebody's future on the position of the stars and planets at the time of his/her birth, i.e. it is a scheme showing the disposition of the heavenly bodies at the particular moment of a person's birth. The traditional astronomers like astrologers construct a horoscope. In this respect, the first one proved himself skilled horoscopist as he lives very much nearer to local people. Moreover, he is not thinking about commercial profit and loss. In constructing horoscope, difficulties arise

for want of suitable almanacs and tables with necessary information. In such cases, traditional astronomers may solve some difficulties by conversion of calendars. However, the matter will reveal to us when we will consider the following sample horoscope.

FIGURE-7.2: Sample of Horoscope



Horoscope is a chart showing position of Planets in the Celestial sphere at one's birth time

Horoscope – North & West Indian format

Mr.Rajendra Singh

Date of birth:15-05-1957(Wednesday,Krishna Dwiteeya)Time of Birth:12Hrs 00Mts.Noon
Place of Birth:Nainital(Longitude: 79E27,Latitude :29N23)

Birth Star : Jyeshta-1st,Charan Moon Sign(Rashi):Vrishchik(Scorpio)Ascendant (Lagn) : Simh(Leo)

Rashi Chakr

7 Rahu Indr	6	5 Lagn(01d) Guru-V*,Yam	4 Varun	3 Mangal
8 Shani-V* Chandr-N*			2 Ravi,Shukr	
9	10	11	12 Ketu Budh-V*	1

Navamsha Chakr

3 Rahu,Yam	2	1 Lagn	12 Shukr	11 Mangal
4				10 Ravi
5	6 Budh	7 Varun	8 Ketu	9 Guru Shani Chandr Indr

*V = Vakri(Retrograde) *N = Neecha(Debilitated)

Position of Planets at Birth time and ruling periods(dashas) for whole life

Planet	Longitude		Star location	Period of	Ruling planet
	Sign	Deg.-Min.		From	To
Mercury(Budh)	Mesh(Aries)	17-15	Bharani-2	15-05-1957	23-05-1973
S/Node(Ketu)	Mesh(Aries)	26-24	Bharani-4	24-05-1973	23-05-1980
Venus(Shukr)	Vrishabh(Taurus)	08-57	Krittika-4	24-05-1980	23-05-2000
Sun(Ravi)	Vrishabh(Taurus)	00-53	Krittika-2	24-05-2000	23-05-2006
Moon(Chandr)	Vrishchik(Scorpio)	17-25	Jyeshta-1	24-05-2006	23-05-2016
Mars(Mangal)	Mithun(Gemini)	13-24	Aridra-3	24-05-2016	23-05-2023
N/Node(Rahu)	Tula(Libra)	26-24	Vishakha-2	24-05-2023	23-05-2041
Jupiter(Guru)	Simh(Leo)	28-35	Uttara-1	24-05-2041	23-05-2057
Saturn(Shani)	Vrishchik(Scorpio)	19-01	Jyeshta-1		
Uranus(Varun)	Karkatak(Cancer)	10-08	Pushyami-3		
Neptune(Indr)	Tula(Libra)	07-21	Swati-1		
Pluto(Yam)	Simh(Leo)	04-40	Makha-2		

Swasti Samasta Sanmangalani Bhavantu

Horoscope – South Indian format

Mr.Kumara Swamy
Date of Birth:15-03-2008(Saturday)Time of Birth:07Hrs 45Mts.P.M
Sarvajit nama samvatastara Phalguna,Shukla Navami
Place of Birth: Kundapur,Udupi(Longitude: 77E35,Latitude :13N00)

Birth Star:Aridra-3rd,Padam Moon Sign(Rashi): Mithun(Gemini) Ascendant (Lagn): Kanya(Virgo)

Ravi			Kuja Chandr
Budh Shukr Rahu,Varun Indr	Rashi		Shani-V* Ketu
Guru Yam			Lagn 17(deg)

		Ketu Varun	Lagn Shani Yam
Chandr	Navamsha		Ravi
Budh Shukr Kuja	Guru Rahu		Indr

*V = Vakri(Retrograde)

Position of Planets at Birth time and ruling periods(dashas) for whole life

Planet	Longitude		Star location	Period of	Ruling planet
	Sign	Deg.-Min		From	To
N/Node(Rahu)	Kumbh	03-29	Dhanishta-4	15-03-2008	20-04-2013
Jupiter(Guru)	Dhanu	24-00	Poorvashada-4	21-04-2013	20-04-2029
Saturn(Shani)	Simh	09-37	Makha-3	21-04-2029	20-04-2048
Mercury(Budh)	Kumbh	06-55	Shatabhish-1	21-04-2048	20-04-2065
S/Node(Ketu)	Simh	03-29	Makha-2	21-04-2065	20-04-2072
Venus(Shukr)	Kumbh	09-17	Shatabhish-1	21-04-2072	20-04-2092
Sun(Ravi)	Meena	01-24	Poorvabhadr-4	21-04-2092	20-04-2098
Moon(Chandr)	Mithun	16-13	Aridra-3	21-04-2098	20-04-2108
Mars(Kuja)	Mithun	09-56	Aridra-1		
Uranus(Varun)	Kumbh	25-03	Poorvabhadr-2		
Neptune(Indr)	Makar	28-57	Dhnishta-2		
Pluto(Yam)	Dhanu	07-05	Moola-3		

Swasti Samasta Sanmangalani Bhavantu

Our Horoscope Report will contain:
1. The above chart - which contains the planetary birth chart, planet positions at the time of birth and the planet periods of the individual
2. A detailed page explaining the disposition of the planets in the horoscope and the positives and the negetives - From which stem the good points and the problems with respect to various life aspects
3. A 4 year Life span prediction of Life events for Immediete Past, Present and Future
4. Recommnedation for correction of any Problems with corresponding gems for planets responsible.

Source: Collected from http://astro-life-solutions.com/sample.html accessed 30/04/2015

7.7 Three Questions: direction, place and time

The use of sky knowledge in prediction purposes, and in the cultural interpretation of starry sky, has long been accepted, but we also describe the use of astronomy in a traditional plus scientific manner. We consider the work of traditional astronomer as an intellectual endeavor to describe the natural world within an appropriate cultural context, resulting in predictive power and practical applications such as navigation or timekeeping. For the measurement of time astronomers develops a unique way, Shahed Hassan (2015) has pointed out, this perspective in his book 'On Nature and Knowledge'-

'Besides, the photosynthesis and Fibonacci sequence in leaves and branches,

trees can teach us to calculate the time and understand climate change in a particular place. Such uniqueness of trees have influenced man to develop a science called 'dendrochronology'. This particular branch of sciences was developed during the first half of the 20th century originally by the astronomer A. E. Douglass, the founder of the laboratory of tree-ring research at the University of Arizona. Douglass sought to better understand cycles of sunspots activity and reasoned that changes in solar activity would affect climate patterns on earth, which would subsequently be recorded by tree-ring growth patterns. Application of tree-rings study is found in climatology, art, history, archaeology, and few other branches of science. The tree-ring thus serves the purpose of calculating dates to the tune of perfection. It is calendar or databook in nature. (Hassan 2015:89-90)'

Dr. Hassan has also pointed out, science of nature regarding direction-

'Today we talk about Global Positioning System (GPS) and its application in navigation by air, water and roads to foster our travel and to locate a place. This technology is relatively new for us. The GPS is a space based satellite navigation system that provides location and time information in all weather condition. Interestingly, scientists have found presence of GPS cells in certain animals. Instead of satellite, it is the earth's magnetic field that helps the animals and birds to move and fly to certain places. It has been observed that certain neurons in pigeon brains encode the direction and intensity of earth's magnetic field, providing the common birds with an internal GPS. It is strongly hold that magnetic receptors in the retina, nose, inner ear, and possibly the beak of birds receive and interpret magnetic field information, which then goes to the brain for processing. The GPS cells in the brain thus signal the direction, intensity and polarity of an applied magnetic field. Besides birds, honeybees, fish, turtles and even a few mammals, such as the blind mole rat are documented as being able to sense and use the earth's magnetic field with their natural GPS cells. In fact, the GPS cells work as internal compass in their brain. Precisely, nature has blessed the animal kingdom with technologies appropriate for them. In contrast, we innovate, experiment and use only when tested with a positive result. Nature has given signs and symbols while we use numbers and alphabets, and other variables i.e. speech, smell, and sight hardly differs. In many cases, we learn from nature without knowing but nature always remains a teacher and guide for us (Hassan 2015:90-92)'.

Chapter-Eight

Conclusion

The rural people of Bangladesh consider the sky to be a part of their landscape; an inseparable component of the natural world. Everything on the earth is reflected in the sky (Mowaljarlai and Malnic 1993), indicated by the numerous oral traditions that discuss beings originating on Earth and then making some sort of voyage to the sky (Johnson 1998). There is a local saying in Bangladesh, 'the land is our mother, and she speaks to us.' As part of the landscape, the sky also speaks to us. It tells us when the seasons change, when the tides come and go, when new disasters are ready to come even how to find our way at night. It is essential for the survival of any culture to understand the sky, be it agrarian or hunter/gatherer (e.g. Aveni 1989 2003; Bauer and Dearborn 1998; Ruggles and Barclay 2000; Urton 1981; Zeilik 1985). Traditional astronomers of Bangladesh are carrying on with their age-old beliefs and notions sometimes with little modified mood. They claim that their astronomical predictions have a scientific basis, whatever little it might be. In general, they lack satisfactory progress in comparison with the mainstream society. This concluding chapter discussed about the migration of traditional astronomer and the impact of colonization and globalization; their present conditions. Considering these, it should remember that maximum traditional astronomers are of Hindu community. So the issue of Hindu migration is attached to the phenomenon as well. At the ending, expectation for further study hoped by the researcher.

8.1 Colonization, Migration and Globalization

There are very few simple truths in anthropology, here is one: ancient civilizations and traditional cultures that all were built by people who are now dead. Though in reality, none of them survive, in the modern imagination, some are interpreted as being more alive than others. Some are represented as having cultural descendants who carry on their traditions. For example, Europeans and Americans often claim cultural continuity with the democracy and science of the ancient Greeks (Dick and Lupisella et al. 2009). Different studies of the literature on aboriginal astronomy (Fredrick 2008; Hamacher 2011) have shown that there is an affluent knowledge of aboriginal astronomy in the text, much of which is based on ethnographic effort. This knowledge covers from simple expressions to complex cosmologies. One of the feedbacks of this knowledge is a debate described by Swain (1993)

as a breaking of the relationship between aboriginal culture and place through the effects of invasion and colonization. As pre-colonization aboriginal culture was predominantly oral in nature, there will never be a satisfactory reconstruction of pre-colonial views of the world in southeast Australia. This could mean that all knowledge in the text is post-colonial, and could be contaminated with the pressure of changes brought about by the course of action. It is important to remember that many traditional cultures of the then Indian subcontinent were damaged by colonization, and a major amount of pre-colonial knowledge about celestial phenomena has been lost. Most of the records available in the literature are colonist records — few of which come from amateur ethnographers. Considering the fact, it can be said that traditional societies are extremely complex and exist in a framework that is foreign to colonial rulers, the present researcher acknowledges limitations in interpreting the available information, which is strongly inclined on the biases, interpretations, and legitimacy of the sources.

Contact with the colonial rulers during the eighteenth century saw the beginning of different epidemic diseases (such as Plague, Cholera etc.) leading to population decimation. This occurrence possesses a negative role in the use of traditional practices. Apart from these, urban migration, detachment from their homelands, changing cultural practices and language forced major changes in Hindu society, which also affected the continuation of traditional astronomy. As other cultural and scientific knowledge entered into exchanges and education systems, Indian astronomy as with other local knowledge became sidelined, assimilated with the colonial knowledge and then was lost. Traditional knowledge of astronomy was not static in time; it was dynamic and changing. Many examples in this thesis cite examples that were generated after colonization. Because of this changing knowledge system, coupled with the effects of colonization, the present researcher cannot clearly differentiate between pre- and post-contact astronomical knowledge. Thus, today there are few individuals who are truly knowledgeable in the area of traditional astronomy. In a modern contemporary context, the native have had over three hundred years of mixing with migrants and colonial rulers through marriage, friendships and collegiality. However, traditional knowledge-holders of astronomy certainly have had significant contact with and have been influenced by colonial rulers as well as issues connected with globalization. Hence, any attempt to investigate true pre-colonial Indian astronomical knowledge can be challenging.

India had never lived the life of ‘splendid isolation’ (Mukherjee 1973: 139). From time immemorial it had important relations with the outside world and made her cultural influence

felt over wide areas beyond the boundary. At the end of British colonial rule when India was partitioned in 1947 based on 'two-nation theory'[7], establishing two independent states – Hindu India and Muslim Pakistan. Bengali Muslims joined Pakistan, emphasizing their Muslim identity. But when the ruling elites in Pakistan started an assault on Bengali Language and culture, Bengali Muslims resisted the attack and stressed their Bengali identity over their Muslim identity, which bound them to Pakistan (Jahan 2002). Pakistan was a conceptual state created from a sense of Muslim nationalism of the subcontinent, which emerged out of fear Hindu domination. As the country was created out of a communal favor, it was natural that state ideologies and policies of Pakistan were shaped in a communal line. The struggle for the claim of ethno-linguistic identity together with the Bengali's struggle for democratic participation and economic well-being grew in strength all through the 1050's and 1960's[8]. Pakistan declared itself as an Islamic republic and it was evident that various minority communities like Hindus, Christians, Buddhists, etc. in East Pakistan started to feel insecure and helpless in their country, while India seems secular and comparatively peaceful country. Thus, traditional astronomers, who are mainly from the Hindu community, have migrated to the West Bengal (a province of India). Oral history of the present inhabitants stated that they migrated to that locality some 6 or 7 decades back from the southwestern side of Bangladesh. They decided to migrate mainly for religious conflicts, side by side for poverty, overpopulation, shortage of cultivable land and other resources (Haider 2001). East Pakistan through the liberation war of 1971 became the independent state named Bangladesh. Initially, traditional astronomers of Bangladesh did not migrate since they hold means and resources to lead life, and religious harmony was uncertain. Nevertheless, intrusion and persecutions started very soon. The dominant Muslim communities of the adjacent areas taking advantage of the situation, gradually started to provoke and threaten them to hand over their land, cattle and other properties to them and leave Pakistan. Socially and economically, Muslims that are more powerful started to grab their lands and livestock by force, threat, or by making forged documents of the land owned by them. As a Hindu community was socially weak, they could not resist this repression. The greatest matter was that the religious state did not offer them protection; instead, the state machinery directly or indirectly helped the aggressors. The helpless Hindu community, including traditional astronomers had no

[7] The Muslim League voiced the demand for Pakistan in March 1940 arguing that the Muslims and Hindus constitute two separate nations and need their separate states.

[8] For more please see Jahan, R. (1972) *Pakistan: failure in national integration*, New York: Columbia University Press.

other alternative, but to decide to migrate to India. The creation of Bangladesh, as a progressive secular country raised their hopes for a short period, but political change in 1975 again began to threaten and their perils did not end. The population of Hindu community is decreasing gradually and if the situation does not improve, it can be assessed that in the near future the traditional astronomers will cease to exist in Bangladesh.

Discussing globalization, Arjun Appadurai (1996) has concentrated on public spheres such as restaurants, electronic media, movies, and sporting events. The focus of the present research was on intimate world of different peoples such as peasants, farmers, fishers, petty businesspersons, rural dwellers and Hindu community who were in the process of encountering neo-liberal capitalism (Ahmed and others 2014). The present study looked at the public spheres of these shining examples of global flows.

8.2 Present Condition

The original traditional astronomer is rare at present in Bangladesh; they are living miserably in different socio-political and economic conditions, which led them partly to be disintegrated (isolation) with the wider Muslim society. In fact, for both have different socio-cultural life and mental aptitude. It is a matter of apprehension that following new generations do not feel any interest in the profession as it is low-incoming one. Necessary steps should allow changing their thinking, otherwise this will extinct soon.

In this age of multi-media, when different occupation's skills and techniques are improving faster than ever before; declining traditional astronomy burdened with age-old tools and skills, day after day they are losing their position. If this trend continues, we may discover traditional astronomy is no more in near future. It is true no activities of them are out of the question; but some of their predictions, especially on weather and climate, agriculture and cattle rearing are more or less certain. In addition, for this reason, yet they have competency in the rural Bangladesh.

In most cases, traditional astronomers are not conscious about their attained knowledge, and even they have no tendency to keep any kind of written record of their skills. The result of this process is simply conjecture- after death, whole life's knowledge of traditional astronomy goes to hell i.e. lost forever. This condition demands change, for this consciousness, the preservation of traditional astronomer's knowledge is needed.

8.3 Concluding Remarks

Astronomy, perhaps the oldest science in history, has played an important role in most cultures over the times. The International Year of Astronomy (IYA2009)[9] seemed as an excellent opportunity to tell the wider public about traditional astronomy so that they might understand something of the depth and complexity of traditional astronomy. Bangladesh is a country that, perhaps, has a large number of astronomy. During a 'Total Solar Eclipse Observation Program' that was organized by the Bangladesh Astronomical Association in Dhaka on October 24, 1995, about 30,000 people converged into the observation site at Sher-E-Bangla Nagar and police had to use force to disperse them and to save the lives of its organizers. On the late night of November 18, 1999, about 20,000 people assembled at the city center and millions stood on the streets and on the top of their houses to witness the spectacles of Leonids Meteor Shower. The reason for their extraordinary love and fascination to observe the sky objects, attributes much to their struggle for survival. However, the present thesis does not come up with a good theory. A good theory satisfies two requirements:

- It must accurately describe a large class of observations on the basis of a model that contains only a few arbitrary elements; and
- It must make definite predictions about the result of future observations (Hawking 1988)

Since traditional astronomy does not yet possess its own unique theoretical framework, research in this interdisciplinary area relies upon the theories of the disciplines from which it draws (i.e. Anthropology, History, Mathematics, and Astrophysics). Clifford Geertz's recommendation for the investigation of science, religion, and other forms of cultural expression to the study of any discipline inspired the present researcher. In the book 'Local Knowledge' Geertz asked- "What form do they take [in various cultures] and given the form that they take, what light has that to shed on our own versions of them" (Geertz 1983:92). The present study, search for the query as well. This thesis also uses the concept of 'human constructivism' (Mintzes with Wandersee and Novak 1997) as a theoretical construct in which to insert the research findings and to explain how traditional astronomers learn and practice at their locality. Although based on constructivism, the researcher adopts a 'modest

[9] IYA2009 was a yearlong celebration of astronomy that took place in 2009 to coincide with the 400th anniversary of the first recorded astronomical observations with a telescope by Galileo Galilei and the publication of Johannes Kepler's *Astronomia nova* in the 17th century. It was intended to be a global celebration of astronomy and its contributions to society and culture, stimulating worldwide interest not only in astronomy, but also in science in general, with a particular slant towards young people.

realist'(Osborne 1996) stance, which combines the advantages of a constructivist theoretical framework in the area of self learning, while at the same time recognizing that there is an ontological reality, which has been established by scientists by repetitive and usual confirmation. It is a reality that traditional astronomers are learning astronomical aspects of their own need and interest, sometimes assisted by their ancestors.

Despite the considerable research into anthropology and astronomy over the past thirty years in Bangladesh, no studies combine the two fields. Theories from a wide spectrum of disciplines (Anthropology, History, Mathematics, and astrophysics) suggest various factors at different levels-

- *Individual Level:* Demographic, socioeconomic, and cultural/religious factors
- *Household Level:* Income/wealth, number of children, the educational choice and the personal autonomy
- *Local Level:* Degree of urbanization, factions and politics
- *National Level:* Political, cultural and economic variables, level of social equality, welfare and impartiality policies, level of development, degree of secularism, and public perception

This overview of theoretical ideas shows the necessity of developing a comprehensive theoretical framework and the relevance of an integrative interdisciplinary approach.

However, some stimulation can be gleaned from the research that may lead to a reassessment of old modes of thought or new discovery in the future. This thesis is merely an opening to the diversified world of the traditional astronomy and astronomers of Bangladesh. It is also sadly limited by insufficient proficiency with traditional astronomy and meager knowledge of modern astronomy. May be the other scholars can pick up where this thesis has left off?

Appendix-1

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Appendix-2

Sample of Questionnaire for the Study

(The collected information & data will be used for academic purpose & will be considered as confidential)

- Place of Data Collection……..
- Code No……..
- Date……
- Serial No……

Part-1: Personal Information

1. Name (Optional):
2. Designation (if any)
3. Sex:
4. Marital Status:
5. Education:
6. Year of joining in the profession:

Part-2: Information of the Traditional Astronomer's Profession, Knowledge, Prediction Areas and Other Related Aspects

To Assess their Professionalism

1. What do you have to do in this profession? (What would a typical day be like?)
2. How much time you have to spend daily (on an average) in professional activities?
3. Do you enjoy liberty in your professional activities?
4. For how many years you are involved with this profession?
5. From whom you have learned this profession?
6. Any of your ancestors, i.e. father, grandfather were involved with this?
7. Do you have any other earning source?
8. If yes what are they? Please mention-
9. Is it a year round profession or seasonal?
10. If seasonal, what are the times important to you?
11. Do you wish to involve your child with this profession?
12. Are they interested in it?
13. Does your family support you in this profession?
14. What motivation keep you committed to this profession?
15. What are the current challenges being identified by you in this profession?

16. Is there anything dangerous, hazardous or risky about this Profession?
17. What are the other fields related to your profession?
18. Have you ever participated in professional programs/meetings/workshop/ seminar/conference etc.?
19. Have you any membership or fellowship of any astronomical association? Please mention-
20. Have you any border extent connectivity? Please mention-
21. Please make a comparison with the present and the past condition of your profession?
22. Do you think training is necessary for professional development? If 'no' why?
23. What advice would you give someone interested in a career in traditional astronomy?

To Understand their Knowledge of Astronomy

1. How would you define traditional Astronomy?
2. How has the field changed over time?
3. What do you think are the most important discoveries or developments in this field?
4. What skills and tools do you use?
   4.1 What are the techniques you following in counting planets & stars?
   4.2 Are those techniques invented by you?
   4.3 If not, why are you following other's technique?
5. How can you identify the planets & stars' position?
   5.1 Do you have any own inventory of stars?
   2.2 If yes, mention the name?
   5.3 Do you take any help from secondary sources?
   5.4 If yes, mention the name of the books?
6. Do you document your inventions or experiences?
7. Who would you call the single most important contributor in this field?
8. Why do people want to learn and know more about astronomy in traditional fashion?
9. How you can proof that all human aspects (like: pains & pleasures, health issues etc.) are influenced by the celestial body?
10. From which classes or age groups, peoples are coming to consult with you?
11. What are the purposes of them, please mention-
12. How 'Logno' (good moments) is being calculated for the bride and groom?

13. Could astronomers prevent problems for humans by gaining more knowledge about traditional astronomy?
14. How do you measure the distance between earth and the sun?
15. Why do stars twinkle?
16. What are falling stars? There is a belief that, if someone wishes something at that moment it will come true. Do you agree? Please put in your opinion-
17. What is that ring (or rainbow) around the moon? Is there any relation of weather with it? Please explain-
18. Who named the planets and who decides what to name them?
19. What are the advantages and disadvantages of using a telescope?
20. What is the observational difference between a star and a planet?
21. What causes seasons?
22. Why do different stars appear with the seasons?

To assess their acceptance and importance in communities

1. What is the people's perception regarding your profession? In detail
2. Do you face any misunderstanding with the clients?
3. What role you are playing in the community? Elaborate
4. What the exact benefits of this profession, you think, for the welfare of the society

To explore the areas where astronomical predictions are prescribed

1. What are the possible areas where astronomical predictions are prescribed?
2. Is there any influence of celestial body on human activity?
   2.1 If yes, how?
   2.2 Is there any variation of influence in time and space?
   2.3 Mention a special context where celestial influence will surely act?
   2.4 Mention another special context where celestial influence will not act?
3. What are the influencing planets, satellites or stars?
4. Is there any influence on other animals and plants?
5. What are the techniques you following to reduce the celestial influence?
   5.1 Are those effective?
   5.2 How?
6. Do you use almanac?

7. Do you make horoscope?
   7.1 If yes, how?
   7.2 Is there any classification of horoscope? Please mention--
8. What's the difference between astronomy and astrology?
9. What are the arguing aspects between astrologers and astronomers?
10. Any collision of conflict with modern development of science and technology with this traditional practice? And what is your recommendation about it?
11. What are the barriers and challenges, social, cultural, religious or etc. and the ways to mitigate those-

To evaluate the effectiveness of different astronomical predictions

1. Why are you taking help from a traditional astronomer in making 'Kusthi' of the newborn baby?
2. Do you believe in favorable and unfavorable moments? How it can be controlled?
3. Is 'Logno' (good moments) calculation is necessary for the marriage ceremony of the Hindus?
4. What is the rate of their success prediction? Justify their calculation?
5. Are their predictions appropriate in cultivation and navigation?
6. Whether is it a family tradition or reformation to visit 'Thakur'?
7. What is the viewpoint of new generation regarding it?
8. Do you have any misunderstanding? Please explain-
9. Is there any religious bindings to visit 'Gonok/Thakur'?

Appendix-3

Abbreviations & Acronyms

A.D.- Anno Domini, (Since the birth of Jesus Christ.)

Agarbati- a kind of stick that make perfumed smoke

am- Ante meridian (before noon)

Amabashya- The night of new moon.

Annaprashonno- Hindu rite of allowing a child to taste the rice for the first time.

Ashuvo- Evil or unfavorable thing.

Barga- An aggregate or a genus.

Bari- Homestead.

B. C.- Before Christ

BANSDOC- Bangladesh National Scientific & Technological Documentation Centre

BCAS- Bangladesh Center for Advanced Studies

Bedh- Perforation.

BELA- Bangladesh Environmental Lawyers Association

BRAC- i) Building Resources Across Communities

ii) Bangladesh Rehabilitation Assistance Committee

iii) Bangladesh Rural Advancement Committee

Chand- The moon.

Chandrasava- The moon-belt.

Chandrayan- Pray for remission of sin.

Danda- Unit of time, which is equal to 24 minutes.

Dasha- Planetary influence.

Debayana- The passage of God.

Dhop- Mobile shop made with tin and woods

Dhup- A kind of powder that make perfumed smoke

Duani- Last two stars in the south sky.

e.g.- Exempli gratia (for example)

etc.- Etceteras

FGD- Focus Group Discussion

Ghoramy- One who builds huts professionally.

Haor- An extensive marsh or wetland.

IARD- Integrated Action Research and Development

i.e.- id est (that is)

Jotirbid- Astronomer.

Jotishi- Astrologer.

Jyotisha Vedanga- The first Vedic text to mention astronomical data, records events going back as far as 4000 BCE, although many archaeo-astronomers believe that this text may include observations from as early as 11 000 BCE.

Kaalpurush- The Orion.

Ketu- the descending node.

Kodale Megh- Axe Spade cloud.

Krishnapaksha- Dark fortnight.

Kosthi- To cast one's detail horoscope; to predict the future of one's life from one's prediction.

Lagna- A suitable or auspicious time.

Lakshmi- A matter of good luck.

Matobbars- Usuallyinformal leader

Mimansha- Settlement outside court

Mohajon- A money lender.

Muhurta- 1/15 part of day or night time.

Murubbis- Elderly persons of the villages

Naag- Snake (literally), Milkyway (astronomically)

N.A.S.A.- National Aeronautics Space Aothority

N. B.- Nota Bena

NGO- Non Goverbment Organization

Pitriyana- The passage of deceased ancestors.

pm- Post meridian (after noon)

Pravaha- a celestial wind that moves the planets (according to Hinduism)

Prohor- Quarter of whole day.

Pujah- Offered worship to deity.

Purbahna- Period of sunlight.

Purban- Obsequies to be performed on certain lunar days

Purbon- Rituals

Purnima- The night of full moon.

Purohit- A priest of Hindu religion.

Rahu- The ascending node.

Rashi- Any one of the twelve signs of the zodiac.

Rigveda- One of the primary and foremost texts of Hinduism.

Salish- Informal body of political organization

Sanatan- Original, true or, actual Hinduism

Shirok- Compare a person or thing with Allah

Sraddho- Funeral ceremony.

Shraddho-shanti- A respectable and well-wishing offering to the manes.

ShuklaPaksha- Bright fortnight.

Shuk Tara- The Venus.

Shuvo- Good or fortune.

Surya- The sun.

Thikuji- A brief horoscope.

Tulshi- A kind of herb plant

Vaishya- Third occupational group in accordance to caste system.

Varnas- Caste system.

Vitabari- Ancetor’s residence, closekin share a common yard with separate household.

Viz.- Videlicet (namely)

Zoagini- A particular conjunction of stars.

Appendix-4

Equatorial Stars

Considering the celestial sphere in mind Roy and Clarke stated that, the stars can be put into three classes:

(a) Stars that are above the horizon for all values of their hour angle,

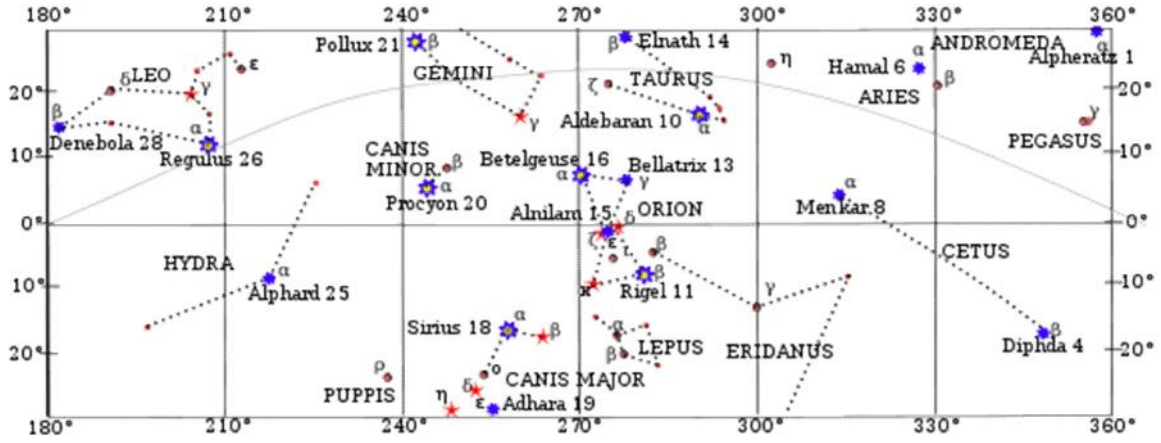
(b) Stars that are below the horizon for all values of their hour angle,

(c) Stars that are seen to rise and set. (2003:63)

However, in this appendix we are merely putting the discussion regarding equatorial stars.

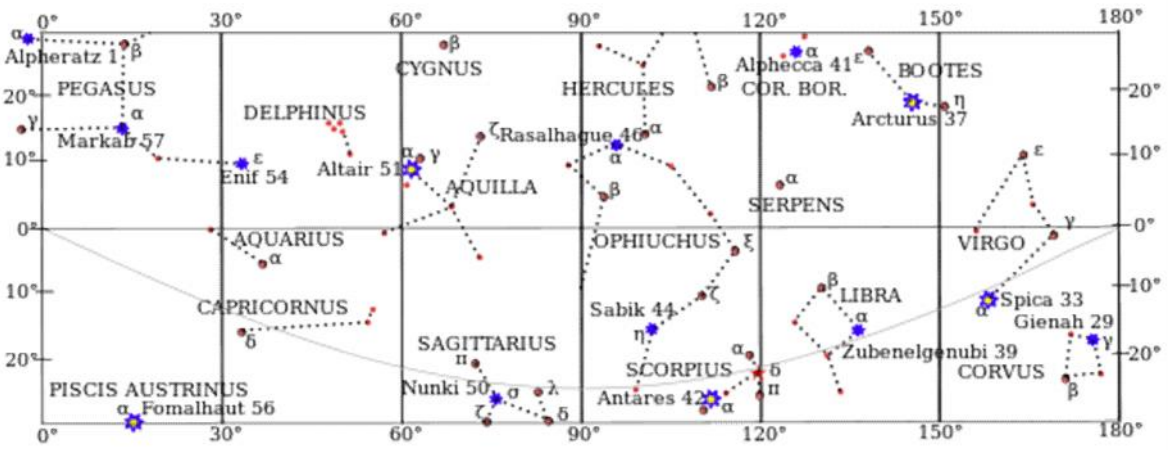
In the Eastern Hemisphere

The equatorial region of the celestial sphere's eastern hemisphere includes 16 navigational stars from Alpheratz in the constellation Andromeda to Denebola in Leo. It also includes stars from the constellations Cetus, Aries, Taurus, Orion, Canis Major and Minor, Gemini, and Hydra. Of particular note among these stars are "the dog star" Sirius, the brightest star in the sky, and four stars of the easily identified constellation Orion.

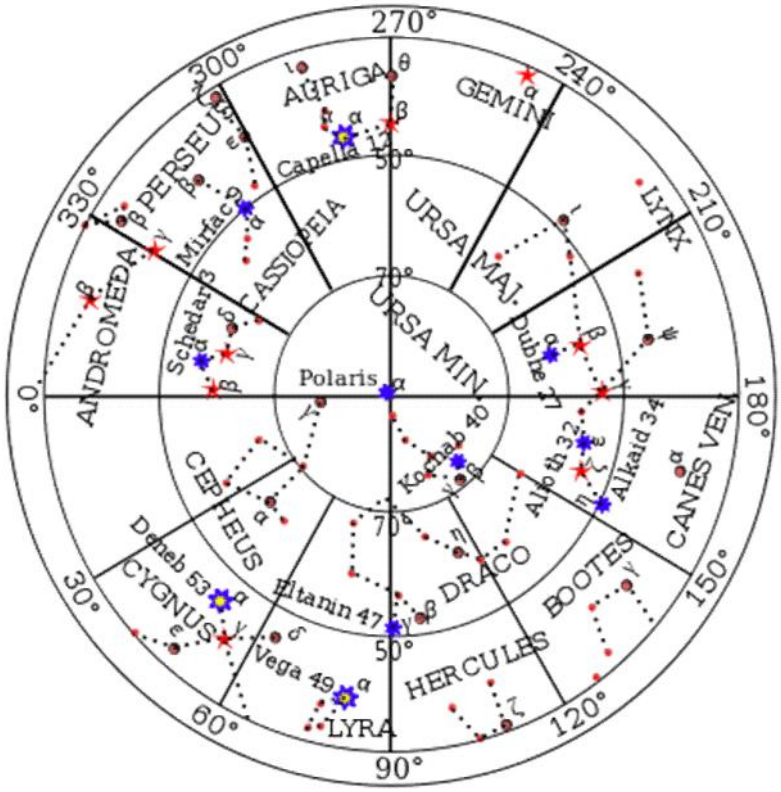


In the Western Hemisphere

The equatorial region of the celestial sphere's western hemisphere includes 13 navigational stars from Gienah in the constellation Corvus to Markab in Pegasus. It also includes stars from the constellations Virgo, Bootes, Libra, Corona Borealis, Scorpio, Ophiuchus, Sagittarius, and Aquila. The variable star Arcturus is the brightest star in this group.



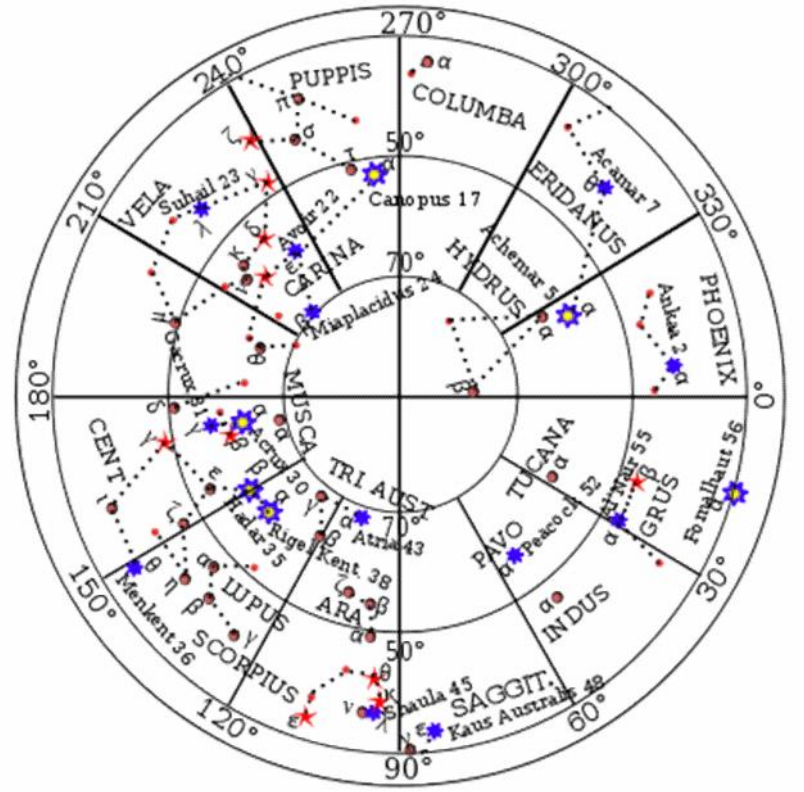
NORTHERN STARS



The 11 northern stars are those with a declination between 30° north and 90° north. They are listed in order of decreasing sidereal hour angle, or from the vernal equinox westward across the sky. Starting with Schedar in the Cassiopeia constellation, the list includes stars from the constellations Auriga, the Great and Little Bears, Draco, Lyra and Cygnus. The two brightest northern stars are Vega and Capella.

In the star chart to the right, declination is shown by the radial coordinate, starting at 90° north in the center and decreasing to 30° north at the outer edge. The sidereal hour angle is shown as the angular coordinate, starting at 0° at the left of the chart, and increasing counter-clockwise.

SOUTHERN STARS



The 18 southern stars are those with a declination between 30° south and 90° south. They are listed in order of decreasing sidereal hour angle, or from the vernal equinox westward across the sky. Starting with Ankaa in the Phoenix constellation, the list includes stars from the constellations Eridanus, Carina, Crux, Centaurus, Libra, Triangulum Australe, Scorpio, Sagittarius, Pavo, and Grus. Canopus, Rigil Kentaurus, Achernar, and Hadar are the brightest stars in the southern sky.

In the star chart to the right, declination is shown by the radial coordinate, starting at 90° north in the center and decreasing to 30° north at the outer edge. The sidereal hour angle is shown as the angular coordinate, starting at 0° at the right of the chart, and increasing clockwise.

Appendix-5

Conversion Tables

TABLE-1: Conversion of mean solar time into sidereal time.

24h mean solar time = (24h +3m 56s556) sidereal time
1h mean solar time = (1h+9s8565) sidereal time
1m mean solar time = (1m +0s1643) sidereal time
1s mean solar time = (1s+0s0027) sidereal time

TABLE-2: Conversion of sidereal time into mean solar time.

24h sidereal time = (24h −3m 55s910) mean solar time
1h sidereal time = (1h −9s8296) mean solar time
1m sidereal time = (1m −0s1638) mean solar time
1s sidereal time = (1s −0s0027) mean solar time